SCIENTIFIC AMERICAN

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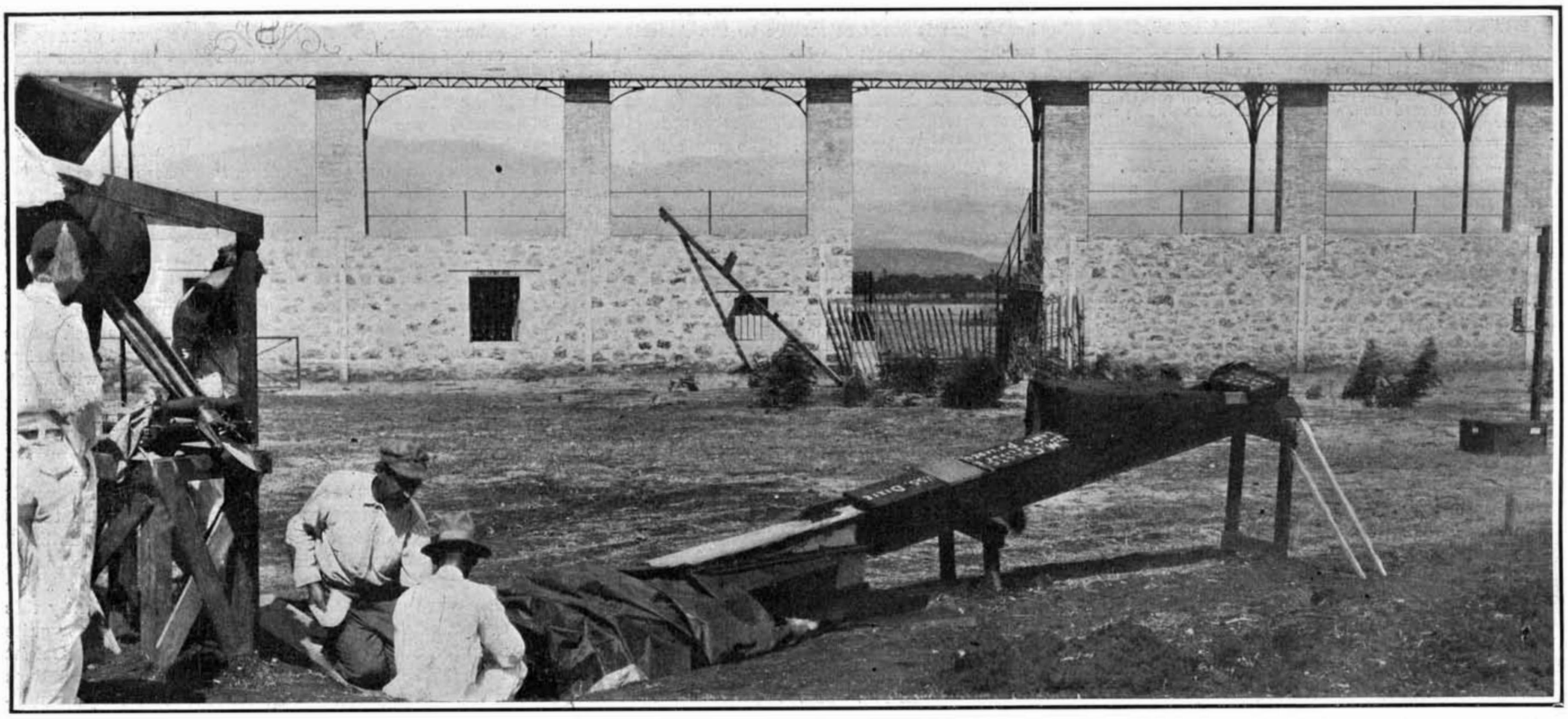
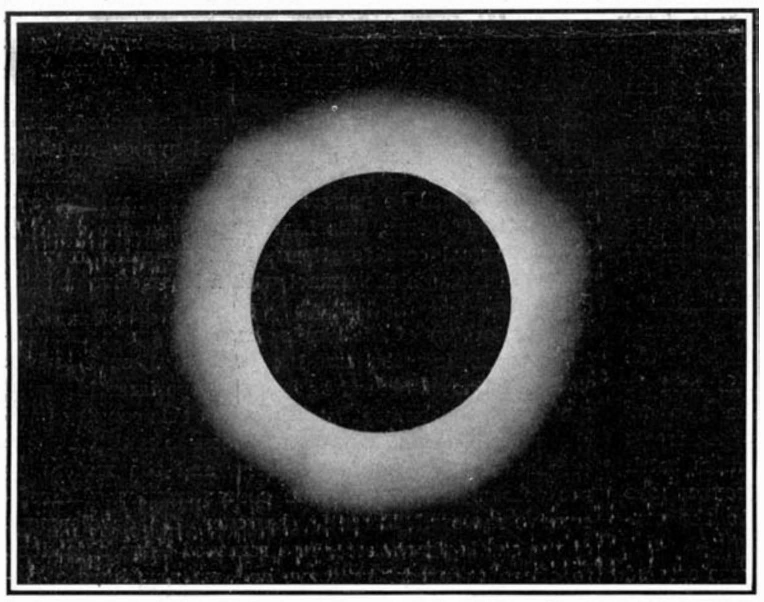
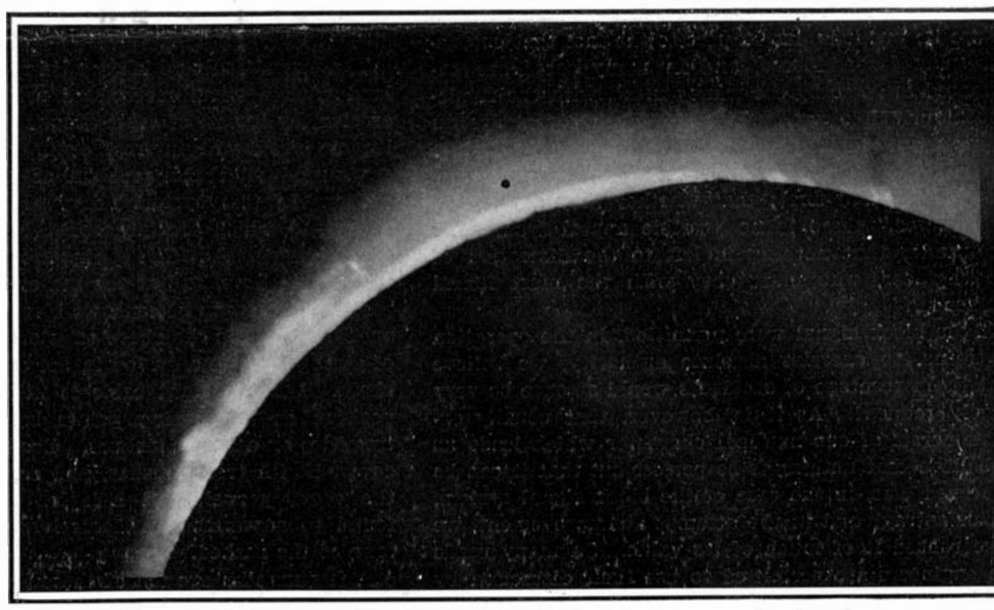


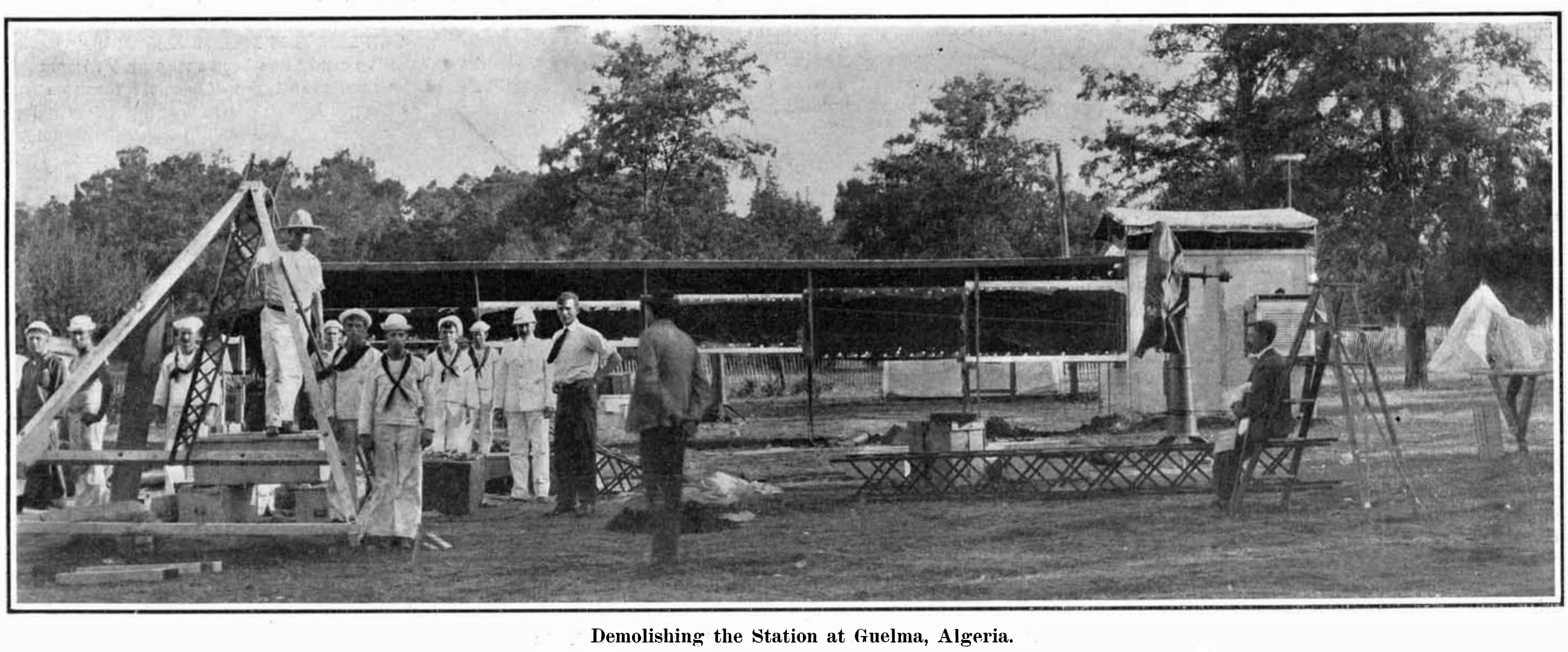
Adjusting the Spectrograph at Guelma, Algeria.



Photograph of the Complete Corona Taken with the 40-Foot Camera on August 30, 1905, at Guelma, Algeria.



Prominences and Inner Corona of the Eclipse of August 30, 1905.



Demolishing the Station at Guelma, Algeria.

STUDIES OF THE TOTAL SOLAR ECLIPSE OF 1905 BY THE UNITED STATES NAVAL OBSERVATORY EXPEDITION.—[See page 153.]

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NEW YORK, SATURDAY, FEBRUARY 17, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

SPEED AND SAFETY IN RAILROAD TRAVEL.

In another column of this issue we publish a letter from a correspondent who proposes, as a safeguard against the perils of railroad travel, that the speed of trains should be regulated by legislation, no train being allowed to run above a speed of forty miles per hour. This suggestion is made as presenting a more effective safeguard than that offered by a correspondent in our issue of January 20, who believes that the use of block signals and the automatic stop is the best solution of the problem of combining high speed and safety. There can be little doubt that, if all things be considered, the best compromise of the several conflicting interests which have to be considered in determining this question, is that of combining high running speed of trains with the automatic block signal and the automatic stop. For it is certain that an attempt to restrict, by law, the speed at which our railroad trains shall be run, particularly if the limit were set at forty miles an hour, would not only retard the progress of our whole system of industrial life, but would so far limit the capacity of our railroads that the lines would become congested, and the risk of accident be proportionately increased.

Our long list of railroad fatalities and accidents is not due to the high speed of trains; it is not due to the failure of the block signal system on such lines as use it; but it is due in part to the fact that enginemen play fast-and-loose, and in many cases are encouraged to do so by the management, with the fundamental principle upon which the block signal system is built up. This fundamental principle is that the commands of the semaphore arm or the colored light are absolute and final; that whether they say "stop" or "proceed," there is no possible appeal from their commands; that nothing is left to the discretion of the engineer, who must obey with the most literal obedience.

If the block signal were permitted, in the operation of trains, to exercise absolute authority, we believe that the percentage of accidents would at once be very largely reduced. As it is, however, that usually excellent trait of our national character which leads us to believe that nothing is so perfect but that it can be improved, has, in the case of the block signal system, led us astray; and in the attempt at improvement, we have robbed it of much of its value. On many roads the engineers are permitted to use their discretion by passing a signal and proceeding cautiously, the object, of course, being to save time by keeping the traffic moving forward. If we would secure the full benefit of the block signal system, this discretionary power should be removed from the engineer.

Furthermore, it may happen that even when the block signal is strictly obeyed, various accidents, which need not be recapitulated here, may prevent the engineer from stopping his train according to the signal; and it is in order to eliminate, as far as possible, these errors, due to the "human element," that the automatic stop has been introduced. Its advantages are so many and so obvious, that one would have thought that this device would have met with quick recognition, with universal recognition, we might say, on those roads which make use of any kind of an automatic signal system. Although various disadvantages have been urged against it by those who are responsible for keeping the traffic moving, we believe that the chief objection rises from the same considerations that led our railroad men to rob the block signal of its proper authority. They look upon the automatic stop as one more hindrance to that unimpeded movement of the trains, which is the prime object of the superintendent and his train dispatcher. We do not believe, however, that the ultimate effect of this device would be to hinder the flow of traffic. On the contrary, if the block signal were made more authoritative, if its commands were backed up by the automatic stop, we should rather be prepared to see the speed of trains steadily increase, as a direct result of the lessened risk of accident.

SUPERHEAT AND BOILER PRESSURES.

It is surprising that the advantages arising from the use of superheated steam should not have led to its earlier use on the locomotive; for it is only during the past two or three years that the superheater has begun to establish itself in locomotive practice. This development we owe chiefly to the Germans, who, with their characteristic thoroughness, are just now paying particular attention to the question of locomotive efficiency. The advantage of the use of superheated steam is that, by preventing cylinder condensation, it renders it possible to obtain from a simple locomotive an economy that compares favorably with that of the compound locomotive. It also permits of the use of a lower boiler pressure without any appreciable sacrifice of economy. This fact should render the superheater particularly attractive to the American master mechanic, to whom the high pressures which are now common are a source of increasing trouble and anxiety.

The great increase in boiler pressure has been one of the striking features in the recent development of the American locomotive. The most rapid increase took place during the decade, 1890 to 1900, when the pressure rose from 160 to 200 pounds to the square inch, several roads making use of the latter pressure. During the past five years 200 pounds has become common, and on some locomotives the pressure has risen to 210 pounds to the square inch; indeed, the writer has ridden on one make of compound, the needle of whose pressure gage was maintained at over 220 pounds to the square inch.

The increase in boiler pressure, like the increase in heating surface, has been due to the ever-present demand for greater power; but as far as the gain in power due to higher pressure is concerned, it has been secured at the cost of several disadvantages, such as increased leakage loss, a marked increase in boiler repairs, and a decrease of earning capacity due to the greater time spent by the locomotive in the repair shop. Now the introduction of the superheater offers a way of escape from the dilemma, a fact which is dwelt upon by Mr. H. H. Vaughn in a paper in the Proceedings of the Master Mechanics' convention, in which he states that, with the proper amount of superheat, it will be possible to return to pressures of 175 pounds or even less without loss of economy.

FORESHORE PROTECTION WITH CHAIN-CABLE GROYNES.

The experiments which are being carried out in Ireland with a novel method of protection against sea erosion, by means of cable groynes, devised by a Dublin engineer, will interest every government that is confronted with the problem of protecting its foreshores. In this system heavy chain cables are employed, to which are attached thorn bushes, or other suitable materials. The chains are laid at right angles to the foreshore, and at the sea extremity are held in position by means of concrete blocks or other suitable anchorage, while the shore ends are secured by means of strong iron pins driven in between the links of the chain. When a light cable is utilized, it is held in position at intervening points between the two extremities by concrete sinkers. The cable is then freely covered with trees, bushes, and so forth, which catch the sand, gravel, and shingle. These groynes are found to accommodate themselves easily to the contour of the seabed.

A few months ago ten of these groynes were erected on the foreshore at Bray, near Dublin. At this point the shore line faces due east, and the conditions are very unfavorable to any protectional devices. The shore is very steep, and there is a triple line of railroad along the shore, protected by a seawall, which is constantly in danger of being undermined. On a stormy day, with the wind dead on shore, the waves wash right up to the wall at low water, and there is a continuous travel of heavy shingle, gravel, and sand, the marl being exposed and subjected to continual erosion through the sawing action of heavy traveling detritus.

With a view to testing the efficiency of the chain groyne system, which is inexpensive to install, the railroad authorities arranged for these ten groynes to be constructed on this principle. The groynes are each about 100 feet in length, commence at mean sea level and extend beyond ordinary low water. They are pinned down to the marl with strong iron bars pointed and capped. They are placed about 130 feet apart. They were installed before the last equinoxial gales, so that the efficiency of the system was submitted to a severe test. The gales raged with great fury from the northeast, but failed to dislodge the structures. Considerable quantities of shingle, sand, and gravel, however, were brought in and still remain, the depth of reclamation at points ranging from 4½ to 5 feet.

The system has established its value, and already it has been decided to apply it to other parts of the British coast where other systems of foreshore protection are either impossible or difficult to carry out. It is anticipated that those at present in position will be carried further out to sea, so as to offer a greater measure of protection.

The installation of groynes upon this method certainly possesses many advantages. The flexible hedge is very adaptable to the inequalities of the seabed, while should it by any untoward circumstance be carried away, it cannot be lost owing to the shore anchorage. Furthermore, they can easily be removed from one point to another more advantageous if desired. The cost of construction is less than that of any other groyning system, while they can be placed in position much more expeditiously. They cannot be impaired by the ravages of the shipworm, are inexpensive to maintain, while it is impossible to destroy the main portion of the structure. It is certainly possible to carry the groyning farther seaward than by any other system, and thus influence the travel of material over areas far greater than has heretofore been possible. The developments and results of the installations are being closely followed by continental engineers, since there are many points around the European coast line demanding protection from the heavy sea erosion now taking place, but where the exigencies do not permit of any of the usual groyning systems being erected.

ELECTRIFYING THE ST. CLAIR TUNNEL.

The announcement was recently made that electric locomotives were to be used in conveying passenger and freight trains through the St. Clair tunnel, and a contract has just been closed for the complete electrical installation, including six locomotives fitted with Westinghouse single-phase motors. This change of motive power is due not only to the difficulty of ventilating the tunnel, but also to the congested condition of traffic at this point. The St. Clair tunnel consists of a single tube about 21 feet in diameter, and over a mile long, with approaches which make the entire tunnel line over 3½ miles long. When the tunnel was built, to provide for ventilation, a pair of tubes were extended from the center of the tunnel to the entrances, where they were connected to large blowers. Evidently this system of ventilation has proved inadequate, for quite recently a serious accident occurred, when a freight train broke in two in the tunnel, and several lives were lost by suffocation in the foul air before the stalled section of the train could be drawn out.

The congestion of traffic at the St. Clair tunnel is due largely to the fact that the freight trains arriving at this point are too heavy to be hauled through by a single locomotive. Consequently, the trains must be divided, and this involves considerable delay. While the approaches to the tunnel are double-tracked, there is only a single track in the tunnel proper, and this also contributes to the delay of traffic. The electric locomotives will be powerful enough to haul through trains of 1,000 tons, this limitation being due entirely to mechanical considerations; heavier trains may be conveyed through the tunnel with a locomotive at each end.

The adoption of the single-phase system is interesting as showing the trend of electrical engineering. While engineers abroad have been experimenting with the alternating-current motors, we in this country have clung to direct-current systems, because multiple-phase currents require a triple trolley, and the motors do not possess the speed-torque characteristics of direct-current motors. Recently, however, the development of the single-phase motor has removed these objections to alternate-current systems, and we now have a motor which combines the advantages of the alternating-current transmission with an efficiency favorably comparable with that of direct-current motors.

THE ELECTRIC FUSION OF GLASS.

An exhaustive study has been made by M. Bronn, of Paris, of the numerous types of electric furnaces constructed for the production of glass, and his conclusions have recently been published in a technical contemporary (Bulletin de la Société d'Encouragement) from which we cull the salient and most interesting features.

Most of these furnaces are of the arc type, which, it is pointed out, have (among others) the disadvantage that there is considerable loss by radiation; in addition to this, when carbon electrodes are used, these latter throw off carbon dust. This latter becomes mixed with the glass, more or less, as its quantity increases with the length of the arc. Endeavors have been made to conquer this drawback by adding oxidizing materials to the raw ingredients, but so far with no great meed of success. Experiments have been carried out with metallic electrodes, but it was found that brass melted, while iron became magnetized and was drawn into contact. In some systems the arc is produced above the glass, an electro-magnet being used to deflect it against the material. In this way certain advantages are secured, but the pointed form of arc raises the glass to a high local temperature, and frequently burns through the side of the container. Tests made with furnaces with this kind of arc show that from 4 to 6 kilowatt-hours are requisite to produce 1 kilogramme (2 pounds 3¼ ounces) of molten glass.

The glass was found to contain much more silicium than the ordinary mixtures, so that this electric furnace should be useful if glasses of this kind are desired; it would be too expensive for ordinary purposes, however. Another furnace, which has some advantages over the arc type, is that in which powdered carbon or cryptol is used as the heating material. In these the ingredients to be fused are placed in a container, which is then surrounded by the resistance material, thus insuring an efficient heat insulation, while at the same time considerably reducing the radiation losses. The resistance material must not be packed in tightly; the grains should also be of uniform size, and evenly distributed round the crucible. If required, the furnace may be arranged in such wise as to produce a higher temperature at one part than at another. One difficulty with this type of furnace lies in the high current intensity employed, but this can now be regulated, thanks to the invention of a suitable regulating rheostat, consisting of an insulated cylinder filled with the powdered material. A block of carbon at the bottom forms one electrode, while the second consists of a rod of carbon, which is pushed down among the loose material. The conducting mass may be distributed around the crucible in several ways; in some methods, for instance, triangular strips of carbon are placed in contact with the crucible with a view to concentrating the current at certain points. In this way the glass may be fused at low temperatures as compared with the temperature of the arc. The furnaces may also be regulated to give any temperature up to 1,600 to 1,700 deg. C., with a precision of from 10 to 15 per cent. The potential employed in connection with these experiments was about 100 volts.

SOME RECENT DISCOVERIES IN OCEANOGRAPHY.

The superficial area of the sea is two and a half times larger than that of the earth, while its mass or volume is enormous. Supposing that the basin holding the seas had been emptied at the time when Jesus Christ was born, and assuming that some enormous river had been allowed to run into it at the rate of 1,093 cubic yards per minute, the basin would still be empty, as it would require a total period of 600 years more before the seas would attain their present level. As may well be conceived, such a body of water must conceal many extraordinary things—but this is a possibility which has attracted attention only within comparatively recent times. The study of the earth itself has been attended with lesser difficulties, but we are now so familiar with our globe that its continents and islands are beginning to pall upon the curious mind, so that more attention is being given gradually to the ocean.

Two of the most prominent oceanographers of modern times are the Prince of Monaco and M. J. Thoulet. In 1899, the Geographical Congress, which met at Berlin, appointed a committee to prepare and publish a bathymetric map. As the necessary funds were not available the Prince of Monaco generously came forward and offered to take all the expenses upon himself, and the map was duly prepared in this way, under the auspices of Messrs. Sauerwein and Tollemer.

This valuable map has just been published and a copy was presented quite recently to the Académie des Sciences. It clearly shows the actual state of our knowledge regarding ocean depths, and the outline or profile of submarine lands, all the data being based upon soundings so far taken by hydrographers and oceanographers of all nations. Moreover, it also indicates the composition of submarine soils.

The map prepared and issued by M. Thoulet is one of the French coast (the submarine portions, of course), up to a distance of six miles from the shore; it shows the depths and—what is an entirely new feature—the lithologic composition of the whole zone in question, and indicates whether the ocean bed consists of mud, sand, stone, shell, rock, or algæ, etc. Devoted as it is merely to a fraction of the ocean, this map is much more detailed, while that of the Prince of Monaco is more a general bird's-eye view of the whole.

So far, but little is known about the bed of the ocean, but a few broad features may easily be picked up very soon, so that after a study of the Prince's map it is not difficult to translate the different shadings of color into differences of altitude, etc.; the student will then promptly discover that there are very many features of resemblance between the earth above and that below the bosom of the vasty deep. In fact, one is practically a replica of the other, both possessing hills, plains, mountain peaks, valleys, ravines, etc. The Atlantic Ocean, for instance, covers two vast valleys; one of these passes between the Cape Verde islands and the Azores, and is of great depth. It runs close up to Europe and comes to an end close to the British Islands, where a ridge or crest of land separates it from the basin of the North Sea. The other valley runs in the main parallel to the first, from which it is separated by an elongated strip of land of which the Azores form a super-marine continuation. This strip does not exceed a depth of 9,850 feet, while its height amounts to 6,560 feet. The first valley, like its *confrère*, is also very deep, its bottom being situated at a depth of nearly four miles below the surface. Passing along South America, and leaving the Bermudas to the left, it passes along Newfoundland and Labrador, finally ending just south of Greenland. The sub-Atlantic landscape thus consists of two vast parallel valleys, separated from each other by a range of mountains. Further north the land lies higher and the sea is, relatively speaking, shallow. Between Greenland and the Continent, close to Iceland and the Channel Islands, there is a huge plain free from any depressions worthy of mention. It is quite clear that at one time England was connected to the continent.

The greatest ocean depths, however, are not found in the Atlantic, as there are veritable abysses to be met with on the other side of the globe. Close to New Zealand the water attains a depth of five and a half miles in the Kermadec and Tonga ravines, which in themselves attain a height of 29,530 feet, while they are separated from each other by a chain of mountains of 9,850 feet height. There is also the Aleutian ravine, which reaches a depth of 23,000 feet. Mostly, sub-aqueous scenery is monotonous; there are no abrupt declivities or precipices, excepting in the vicinity of the coasts or near islands of volcanic formation, everything being rounded off and smoothed down by the action of the water. Close to the land there is somewhat more variety. The European plateau, for instance, slopes gradually away down into the depths, and a fair view can be obtained there, provided a maximum depth of 1,300 feet be not exceeded. At first, abundant vegetation and animal life are met with, but below the depth mentioned the scene changes; first, the light grows dimmer and dimmer, and the deeper we descend the lower does the thermometer fall, except in the case of the Mediterranean, where the temperature is, relatively speaking, high, as this sea is contained in what is practically a closed basin. In the Atlantic, by means of special bottles invented by Dr. Richard, one of the Prince of Monaco's collaborators, the temperature of the water was taken for a depth of 19,686 feet. The surface temperature of 68 deg. fell to 38 deg. at a depth of 6,562 feet. "After 2,000 meters" (6,562 feet), says Mr. C. Sauerwein, another of the Prince's collaborators, "the temperature falls but slowly as greater depths are attained, the cold being practically uniform and not subject to any changes of season."

Cold, darkness, and monotony—such are the characteristic features of the ocean bed. The composition of the floor itself is the only thing that changes, though this is only the case close to the coast, as no alteration (or very little) seems to occur at great depths. Investigations made with drags, dredgers, sounding apparatus, and the like, have shown that it is an error to assume that the bed of the ocean is covered with sand, as this latter is essentially a coast formation only found in comparatively shallow water, close to the shore. Mud begins to take its place the further we go afield—mud, or rather, ooze. Its origin varies considerably; a part consists of the alluvial deposits brought down by rivers. This ooze is of various kinds. Blue ooze is found close to schistous coasts, and its hue is imparted to it by organic substances and iron pyrites; it covers the floor of the Mediterranean and of the Arctic Ocean. Red ooze is merely the blue variety changed in color by the peroxidation of the iron; it is also formed of the alluvial deposits brought down by rivers flowing through land rich in iron, such, for instance, as the Congo and some rivers in Brazil. Green ooze, finally, owes its color to glauconite; it is found along rocky coasts where there are no rivers. In many places the sand or ooze is mixed with volcanic elements originating from terrestrial and submarine explosions. The inorganic world, however, is not the only source from which the ocean bed receives its supplies of material. The remains of organic creatures also contribute no mean share. The upper strata of the sea swarm with teeming animal life—algæ, crustacea, eggs, larvæ, etc.—of all kinds, which die daily in thousands and slowly sink downward to the lowest depths of the sea, thus forming a continual rain of corpses of algæ, diatoms, *et hoc genus omne* which descend from heights far exceeding those of Mt. Everest (33,756 feet) and other lofty terrestrial peaks. Protozoidal forms, foraminiferæ and radiolariæ (over a million of which would not weigh an ounce, but which are so fertile that one specimen can produce 70 million direct and indirect descendants in four days) also play a highly important part in this work. Due to their shells, the foraminiferæ form large quantities of calcareous deposits. The globigerinæ and orbulinæ (members of this family) form a special ooze which is found in the bed of the Atlantic, while the radiolariæ form silicious deposits which abound in the Pacific and Indian oceans, where a special kind of ooze is also found, viz., the pteropod ooze composed of the shells of pteropod mollusks which is found at the bottom of the Atlantic between Africa and America and near the Azores. These oozes, however, are not permanent, but merely represent a phase or stage. Red, blue, and brown clay is the only permanent compound; it is soft, greasy to the touch, and contains from 1 to 20 per cent of lime, a little vitrifiable earth, and organic remains. The oozes referred to above gradually turn into red clay, which thus becomes the final tomb of all that has lived, moved, and had its being in the sea.

A good deal more might be said about the strange beings which inhabit deep waters, feeding upon the bodies and excrementa continually raining down from the upper layers of the waters. But oceanography is not a pursuit of mere curiosity; its aims lie deeper and are of greater value, viz., the determination of the configuration and lay of submarine lands so as to facilitate the laying of cables, the discovery of spots where submerged peaks lie so near to the surface as to be a menace to passing ships, and the sounding of vast abysmal depths. Further than this, the sea and the sun are two great factors determinative of climate, and this is another reason why oceanography cannot fail to be of the greatest interest and value to mankind.

Meantime, the publication of the new maps in question has proved of immense value, and too much honor cannot be paid to the Prince and his collaborators for their devotion to science—a devotion which so far has brought them nothing but empty admiration and eulogies.

SCIENCE NOTES.

Some interesting facts concerning the mineral adulteration of textiles in every-day utility have been published by the Lancet, of London. According to this authority, whereas one hundred years ago the rustling of a lady's silk dress was attributable to the high quality of the silk, it now rustles owing to the impregnation of 36 per cent of salts of tin. Epsom salts, which have hitherto been mostly employed for medicinal purposes, are widely adopted for giving weight to flannel. Similarly, the old-fashioned pure linen used for table cloths is now largely substituted by cotton filled with china clay, starch, and size, while our linen collars are also founded upon base materials with simply a linen facing.

The process of slow distillation of metals readily fusible in a perfect vacuum, elaborated especially by Herr Karlbohm, has for some years led to results so favorable that it was desirable to see these processes extended to metals less fusible. Vessels of quartz are now coming into more general use with the result that much progress has been made in their manufacture as described by Herr Krafft in the Chemische Berichte. When the quartz reservoirs are not too thin, they may be raised to the temperature of 2,552 deg. F., while sustaining a perfect vacuum, without fear that they will be crushed by the effect of atmospheric pressure. At this temperature he has obtained the rapid distillation of a series of metals, among which are zinc, cadmium, silicium, tellurium, antimony, lead, bismuth, and silver. Copper and gold also distill at the maximum temperature of the experiments, but more slowly; their rapid distillation would require a higher temperature. The experiments have been confined to the laboratory, but the results have been so decided and encouraging that their application to the industrial rectification of metals is expected.

A series of interesting experiments to investigate by means of kites the relationship between the circulation of the upper and the lower strata of the atmosphere, in order to know what winds to expect, are to be carried out by the British Meteorological Society, which has devoted a portion of the government appropriation to this work. An experimental station is to be established in England, and instruments provided for kite ascents and other methods of investigations. The researches are to be international in character, for on certain days kites will be sent up simultaneously in England, France, Germany, and Russia. Mr. W. H. Dines, F.R.S., who is the leading authority upon this subject in England, will superintend the experiments, and he will be assisted by Col. Capper of the military balloon section at Aldershot, and Capt. Simpson of the steamship "Moravian," during his passages between Plymouth and Australia. The vessel will be provided with suitable kites, wire, winch, and the ingenious meteorograph, the invention of Mr. W. H. Dines, who has carried out important work in this branch of meteorological investigation on a government vessel off the west coast of Scotland. In these researches a string of kites was used, the largest of which was 12 feet high, with an area of 156 feet, and a weight of 20 pounds. The kites were flown on steel wire hawsers attached to a winch, wound by steam. A height of 10,000 feet was reached and recorded. The greatest danger attending these investigations is the liability of the steel wire being fused by lightning during thunderstorms.

MERCURY ARC RECTIFIER FOR CHARGING STORAGE BATTERIES

BY A. FREDERICK COLLINS.

In garages it often becomes necessary to convert an alternating current into a direct current for the purpose of charging storage batteries, and heretofore this has only been possible by means of a motor-generator set, rotary converter, synchronous or mechanically driven rectifiers, and chemical rectifiers.

Obviously all the foregoing arrangements, except the chemical rectifier, necessitate moving parts that are subject to wear and hence require frequent adjustment, besides being expensive to install. An attendant who has had some experience with electrical appliances, must also be provided, and this further adds to the operating expenses. As to the chemical rectifier, it has never been developed to any degree of efficiency and has never been a very satisfactory piece of apparatus.

For these reasons there has existed for a long time a demand for a cheap device for rectifying or converting alternating current into direct current that should be at once compact and efficient and not apt to get out of order. The General Electric Company's mercury arc rectifier shown in the illustration fulfills these conditions to a nicety since it is lower in first cost, higher in efficiency, and more simple in its details than mechanical converters. It requires practically no attention, and for charging electric vehicle batteries it is almost ideal.

For a number of years the above company has conducted a special department for the development of apparatus used in storage battery practice, and the present appliance is the outcome of a long series of experiments. The mercury arc rectifier and the equipment furnished with it has been thoroughly tested; and no point essential to safety and economy in charging storage batteries has been overlooked or neglected. It is therefore especially serviceable for the charging of electric automobiles in private garages.

The complete equipment comprises essentially a panel, tube holder, and compensating reactance, and these various parts will be described sufficiently in detail to make their uses clear. On the panel, which is made of slate, are mounted the measuring instruments, namely the ammeter and voltmeter, double pole switches by which the direct and alternating current mains are brought into relationship, and also double and single pole switches for starting and operating the rectifier; fuses and circuit breakers are also provided for protecting the rectifier against heavy overloads.

The panel is mounted on one-inch supporting tubes and these, with braces, clamps, and flanges, enable it to be rigidly set up anywhere in a few minutes; to one of the supporting tubes a starting resistance is attached, as a reference to the illustration, Fig. 1, showing the rear view, will indicate. This resistance is connected in multiple with a pilot lamp mounted on the front of the board. The object of the starting resistance is to permit the rectifier to start before the load or charging current is thrown on. The object of the pilot lamp, which is connected in shunt across the

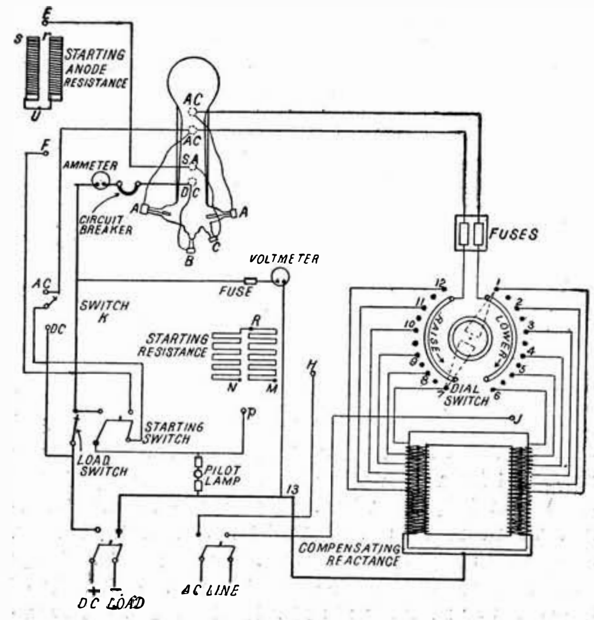


Fig. 4.—CONNECTIONS OF MERCURY ARC RECTIFIER AUTOMOBILE CHARGING PANEL.

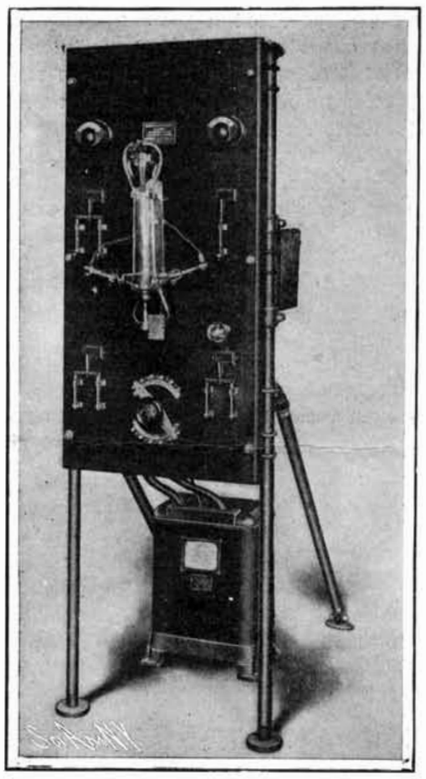


Fig. 3.—FRONT VIEW OF A MERCURY ARC RECTIFIER.

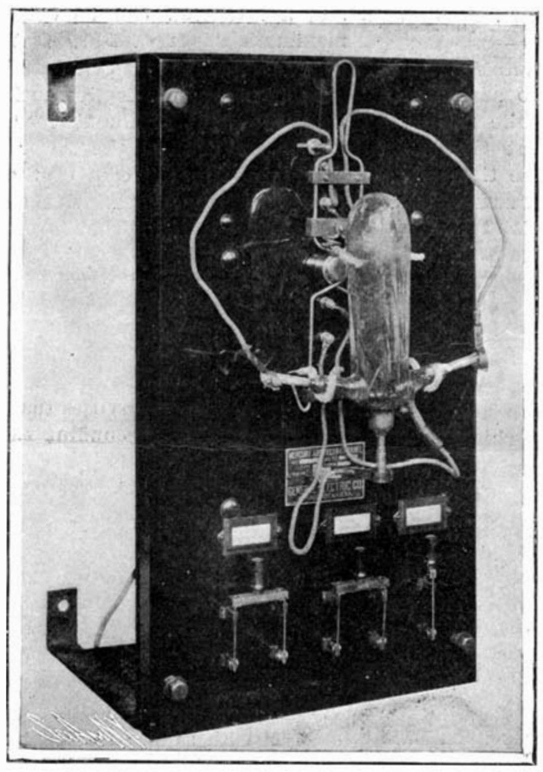


Fig. 6.—FIVE-AMPERE RECTIFIER FOR DENTAL MOTOR.

starting resistance, is to show when the load or charging current takes the place of the starting resistance, the lamp remaining lighted until this substitution is effected.

The rectifier proper consists of a glass tube, Fig. 2, supported on the front of the switchboard, Fig. 3. In the bottom of the tube is placed the mercury, and, after the terminals are sealed in, the tube is exhausted. Two of these terminals, *A A*, are anodes or positive poles. Besides these there is a smaller anode or positive terminal, *C*, for starting the rectifier; the two main anodes, *A A*, lead to the dial switch, and then through the compensating reactance to the main alternating current line. The lower terminal, *B*, leads to the direct current load, that is, to the negative side of the battery to be charged; while the opposite side of the line connects with the compensating reactance. All of this may be plainly observed by referring to the accompanying diagrams, Figs. 4 and 5. The electrodes or poles are provided with metal caps as a protection from burning out as well as for reducing to a minimum liability of breakage. The tube is held in position on the front of the panel with spring clips, while binding posts for connecting the various parts of the tube with the apparatus are mounted on the panel.

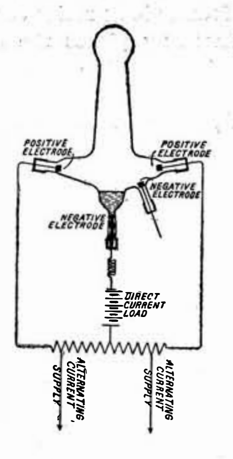


Fig. 5. SIMPLE DIAGRAM OF RECTIFIER CONNECTIONS.

Connected directly across the alternating current supply mains is the compensating reactance; and this is sometimes mounted on the back of the panel or placed under it on the floor. From the reactance leads are brought out and are connected to a dial switch mounted on the front of the panel. The purpose of this switch is to vary the voltage and current within the limits of the rectifier, and the value of the former may be anything from 16 volts to 120 volts direct current. The negative side of the direct current circuit is obtained from the center of the reactance.

Three different sizes of the rectifier are now ready for installation, i. e., 10, 20, and 30 amperes, while any voltage found in commercial use on alternating current circuits can be employed with the mercury arc rectifier. Outfits of standard sizes have been designed and these work on either 110 or 220 volt alternating current, 60 cycle, single-phase circuits. It has been found that for batteries requiring a range of voltage from 45 to 115 volts direct current, 220 volts alternating current will give the best results, while for batteries for smaller power having a range of from 16 to 45 volts direct current, a 110-volt alternating current gives the best results.

According to the arrangement of the connections, the direct current voltage will be found to range from 20 to 55 per cent approximately of the alternating current taken from the supply mains, while the alternating current under similar conditions is from 40 to 65 per cent of the delivered direct current. The standard outfits will operate on any frequency from 25 to 150 cycles very satisfactorily. They are, however, designed especially for 60 cycles, but when used on higher or lower frequencies suffer but little in consequence.

The efficiency of the mercury arc rectifier depends largely on the voltage of the direct current used, since there is about 15 volts constantly lost in the arc. Thus, although it is only about 60 per cent at 30 volts output, it reaches a maximum efficiency of 80 per cent at 115 volts. The shape of the efficiency curve differs from that of the motor generator set formerly employed, in that its efficiency at partial loads is as high as the full load efficiency. This is true also of the power factor, which is extremely high for a converting apparatus of this capacity and seldom falls below 90 per cent, while it frequently exceeds to a considerable extent this value.

Should it be desirable to charge at a higher rate than 30 amperes, two or more rectifiers can be connected in circuit and the capacity can in this way be doubled. The panels on which the instruments are mounted are arranged so two sets may be thus coupled up in multiple, although it is pointed out by the manufacturers that a single set especially designed for the current strength to be used is preferable since it is simpler in construction and easier to operate. These rectifiers may be used with any kind of storage batteries and cannot possibly do any harm. According to the president of one of the largest storage battery companies in the country, charging by a recti-

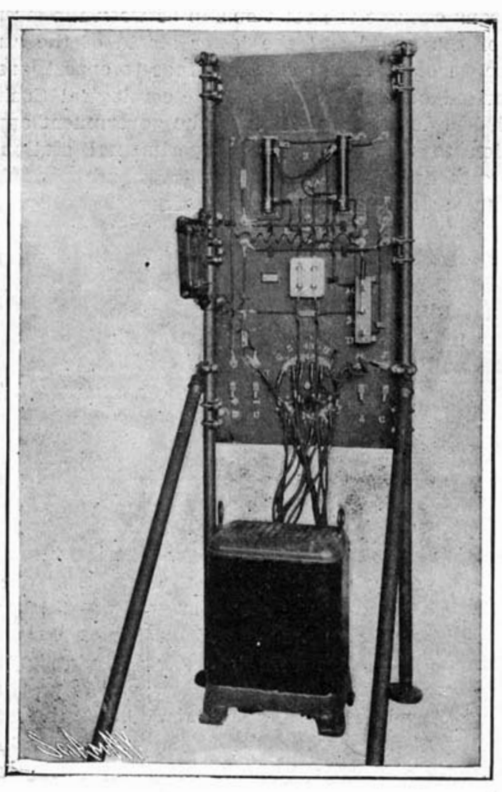


Fig. 1.—REAR VIEW OF MERCURY RECTIFIER.

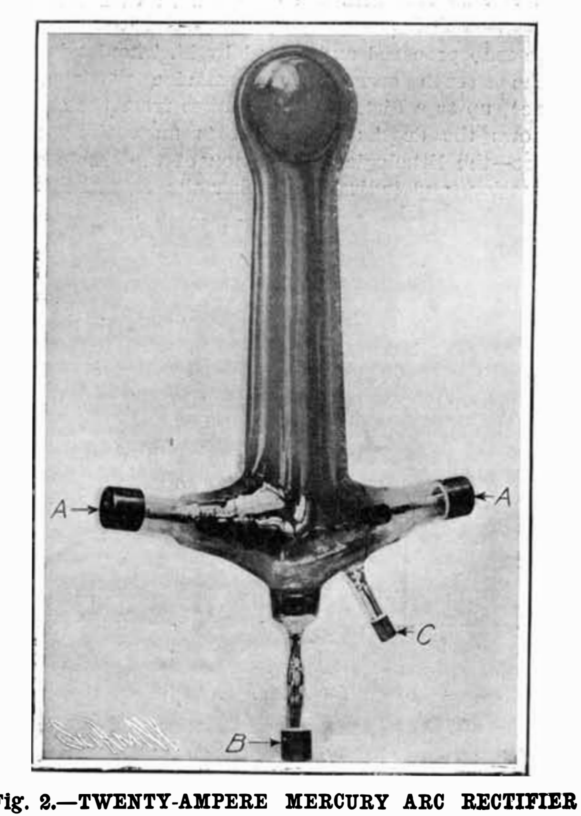


Fig. 2.—TWENTY-AMPERE MERCURY ARC RECTIFIER TUBE.

fier is more efficient, that is, there would be less loss of energy than with a continuous current, as the charging is carried on at a lower rate, more time is allowed for the chemical action to take place, and the gassing of the battery is less.

In Fig. 6 is shown a small rectifier outfit designed to meet the demands of dentists who are often confronted with the problem of operating dental motors where only an alternating current is available. This consists of a small 5 ampere tube arranged to operate on 110 volts, 40 to 140 cycles, and to deliver approximately 5 to 15 amperes at any direct current voltage up to 45 volts. The panel is not equipped with either meters or regulating devices, since it is the customary practice to provide dental motors with these.

THE TUNNEL UNDER THE SEINE RIVER.

BY L. RAMAKERS.

Work has been commenced on the construction of line No. 4 of the Metropolitan Underground Railway of Paris, the north-and-south cross town line, extending from the Clignancourt gate to the Orléans gate, and crossing both branches of the Seine.

The construction of a railway tunnel under the Seine at any point constitutes so difficult a problem that the Prefecture of the Seine deemed it expedient to invite competitive solutions. The commission in charge of the competition, which included both plans and methods of construction, selected the solution offered by L. Chagnand, one of the ablest of Parisian contractors, according to which the cost of construction will amount to 15,614,000 francs ($3,203,000) for a tunnel 1,093 meters (0.68 mile) long, with a station at each end.

In the plan annexed to the announcement of the competition the tunnel descended 40 millimeters to the meter (4 to 100) to a point vertically under the bank of the Seine. The next section of the tunnel was to be horizontal, with the rails 14 meters (46 feet) below the surface. This section was to extend from the Place du Chatelet to a point two-thirds of the distance across the small arm of the river, beyond which point there were to be two rising grades of 40 millimeters to the meter (4 to 100) separated by a level, corresponding to the Place St. Michel, the Boulevard St. André and the Place St. André des Arts.

The tunnels and stations were to be of the following types:

The tunnels were to be two in number, circular in section, excavated by the compressed-air method, and lined with metal. Each tunnel was to have an internal diameter of 5 meters (16.4 feet) and an external diameter of 5.30 meters (17.38 feet), the axis of the tunnel being situated 1.40 meters (4.6 feet) above the rails. The stations, also constructed with the aid of compressed air, were to be short, metal-lined tunnels of circular cross-section, with an internal diameter of 6.50 meters (21.32 feet) and an external diameter of 6.90 meters (22.63 feet). The center of the section was to be placed 1.534 meters (5.03 feet) above the level of the rails and 1.190 meters (3.8 feet) distant, horizontally, from the middle line of the track. This eccentricity would leave room for a landing platform made of armored concrete.

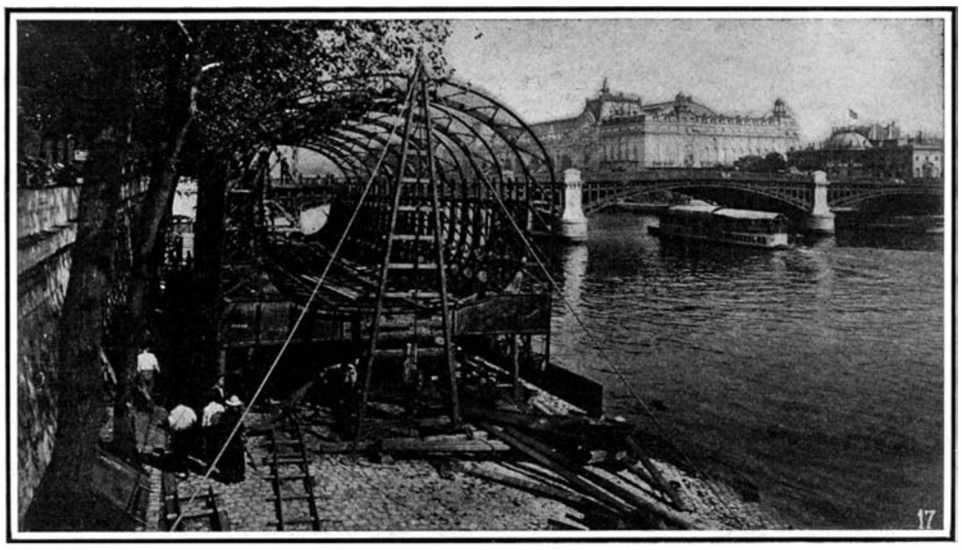
The advantages presented by the Chagnand project and which led to its adoption are of two kinds.

1. Instead of employing twin tunnels of small bore, it keeps the two tracks together in a single tunnel of the same dimensions as the other sections of the Metropolitan.

2. The construction of the tunnel under the Seine by means of caissons sunk vertically makes it possible to raise considerably the level of the rails under the river and, consequently, to diminish the grades of the approaches and the depth of the stations. In the plan adopted the lowest level of the rails is level 16.05, or 11.15 meters (36.57 feet) below the surface of the Seine, while in the original plan it was level 13.10, or 2.95 meters (9.67 feet) lower.

In the Chagnand project the grade of 4 per cent., which is the maximum grade allowed in the Metropolitan system, is employed only in order to pass under the Metropolitan line, the Orléans railway, and the Bièvre collecting sewer.

The internal section of the tunnel differs very little from that of a masonry tunnel of the ordinary type. Except under the bed of the Seine the tunnel will be excavated with the aid of a shield of special design. The walls will be composed of cast-iron rings 60 centimeters (2 feet) broad, the rings themselves being built up of voussoirs of varying curvature, according to their positions and the pressures to which they are subjected. The pieces are to be bolted together, the joints being made water-tight by the interposition of strips of creosoted wood. Cement will be injected behind this iron tube to fill any cavities that may exist between its exterior and the surrounding earth.



Erection of the First Caisson on the Quai des Tuileries.

The metal lining will itself be lined, successively, with a layer of armored concrete of thickness equal to the height of the ribs, and with a coat of Portland cement. In the sections beneath the two branches of the Seine the metal tube of the tunnel is to be constructed as described above, but surrounded by a metallic framework which shall serve as the caisson, thus enabling the tube to be sunk vertically into place. The sides of the caisson are composed of sheets of iron attached to the framework surrounding the steel lining of the tunnel. These sheets rise to the level of the foot of the arch and form a water-tight box which can be transported by floating. The entire space inclosed between the sides of the caisson and the tunnel will be filled with cement concrete, in which the framework will be buried and which will form a layer of strong and indestructible masonry surrounding the metal lining of the tunnel.

Three caissons will be used for the larger and two for the smaller branch of the Seine. The ends of these caissons are closed temporarily with sheets of steel which must be removed when the sections carried by the several caissons are joined to form a continuous tunnel. These junctions will be effected by small caissons operating in the intervals, 1.50 meters (5 feet) long, which will be left vacant between the ends of the sections of the tunnel. By sinking two of these small caissons two masonry walls will be built, connecting the bases of the large caissons and rising to the level of a horizontal ledge at the end of each. Upon these ledges and walls will rest a third small caisson, within which the sections will be connected and the temporary sheet-iron ends removed.

The two stations included in the plan, situated at the "Cité" and the Place St. Michel, will also be sunk by means of caissons similar to those employed for the tunnel under the Seine, but of greater dimensions.

The execution of the entire project of crossing the Seine will involve the employment of three very different methods of working:

(a) Compressed air and a shield will be used for the construction of three sections of the running tunnel.

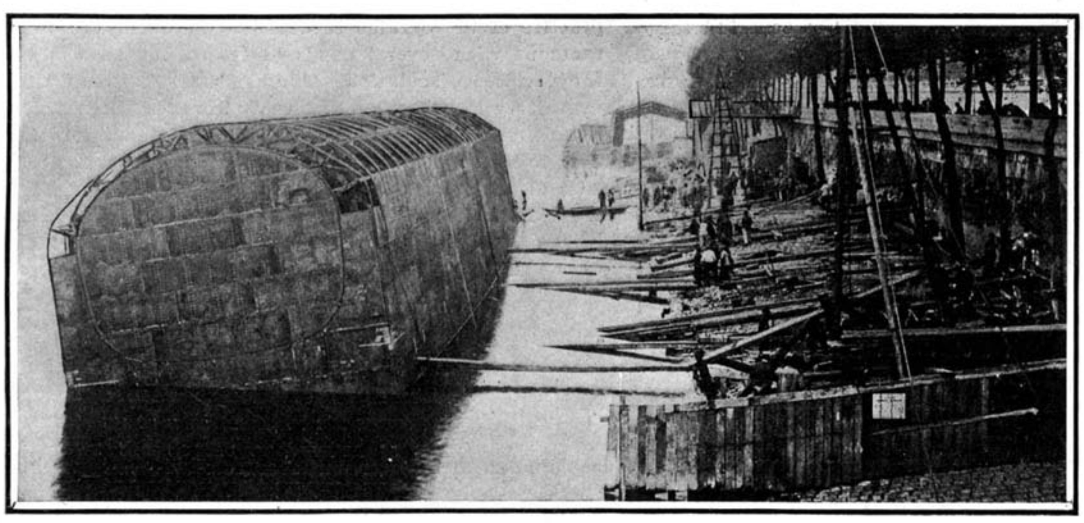
(b) Compressed air caissons will be employed for the tunnel under the Seine, part of the underground tunnel and the Cité and Place St. Michel stations, with their entrance shafts.

(c) Excavation by freezing process will be employed in the passage under the Orléans railway, in order to avoid the possibility of an interruption of traffic due to settling.

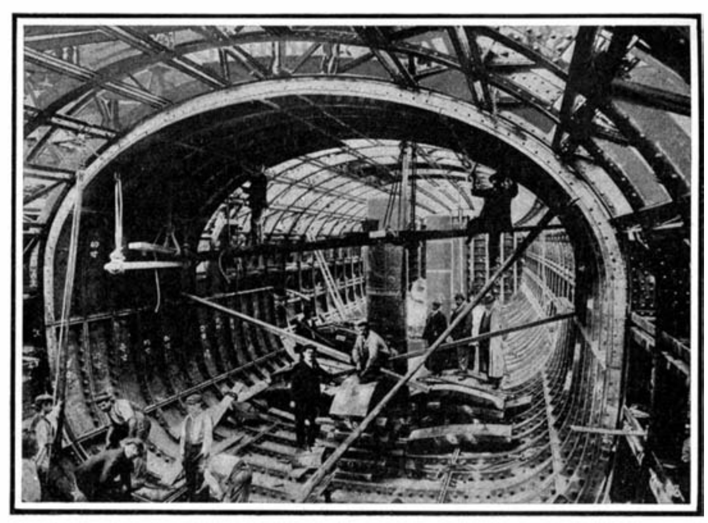
Of these three methods of working the second alone is in full operation. At present the first caisson, on the right bank of the larger branch of the Seine, is entirely submerged and has been sunk to within about half a meter of its final level.

The caissons for the stations will be built on the ground and, when completed and ready for sinking, will present the appearance of huge iron frames, 12.50 meters (41 feet) high, 16.50 meters (54.12 feet) wide, and 68 meters (223.64 feet) long.

As no suitable ground for the construction of the river caissons was available near the points where they are to be submerged, a construction yard has been established at the Quai des Tuileries. One of the illustrations shows the first caisson at the moment when the framework was completed. Its construction was effected quickly by the employment of improved methods, particularly the method of riveting with pneumatic hammers. The caisson having been built and the plates which make it water-tight riveted around it, it was launched sidewise—an operation which was facilitated by the elevation of its site, 40 centimeters (1.6 feet) above the level of the Seine. The caisson, which weighed 280 tons, was then towed to the point where it was to be sunk. Here the stream had been dredged to a depth of 5 meters (16.4 feet) in such a manner that the caisson could be sunk upon a perfectly horizontal bed. On the downstream side of the emplacement guiding piles had been driven, against which the caisson rested. These piles formed the first part of a solid stockade of piling serving, on the one hand, to protect the caisson and, on the other, to support a broad platform. The first work done after the caisson was in place was, of course, the construction of the iron lining tube of the tunnel. Then concrete was poured between the tube and the exterior envelope until the caisson rested solidly on the bed of the river. Then the shafts which give access to the working chamber and the air locks which surmount them were put in place and the sinking by means of compressed air commenced. When the final level is reached the working chamber will be filled with concrete, the tunnel will be emptied of the water with which it was filled in order to ballast the caisson and facilitate its descent, the shafts will be removed and the openings through which they communicated with the interior of the tunnel will be carefully closed. In this caisson the telephone has been employed—for the first time to the writer's knowledge



The First Caisson Launched Sidewise.



Construction of Iron Lining Tube.

THE TUNNEL UNDER THE SEINE RIVER.

—to assure permanent communication between the interior and the exterior. One instrument is placed in the working chamber, the other in the superintendent's booth on the platform of the caisson.

Engineering Notes.

What is probably the highest dock in the world has recently been completed at Port Florence, on the Victoria Nyanza, in Uganda, at an altitude of 3,700 feet above sea level. The dock has been constructed to accommodate the Nyanza fleet plying on the lake in conjunction with the Uganda railroad. It measures 250 feet in length by 48 feet wide and 14 feet deep. It is excavated out of the solid rock by native labor, and occupied twelve months in construction, at a cost of $20,000. Both the time occupied and the cost of the undertaking were increased owing to plague visitations, which seriously interfered with the work.

After an accident which occurred to a flywheel in a large European electric station, the superintendent designed and had constructed a flywheel of wood more than 35 feet in diameter and 10 feet wide at the rim. The thickness of the rim is about 12 inches and is constituted of 44 thicknesses of beech planks with staggered joints. The boards are glued together and the whole is bolted. The inside of the flywheel is formed of a double wheel with spokes and the latter are fastened to two hubs. The twenty-four spokes and the hubs are of cast iron. The weight of the flywheel is nearly 50 tons. On the first trial it attained a speed of 76 revolutions per minute, which corresponds to about 120 feet per second at the rim. It is probable that this is the highest peripheral speed which has yet been obtained with a wooden wheel, and it is one of the highest even from an absolute standpoint. As to size, the flywheel seems to hold the record.

In European countries the development of canal traffic is receiving special attention from the various governments, according to a recent report, published by the British Foreign Office. In Germany these waterways are to be brought up to date, for which purpose an expenditure of $83,643,750 has been sanctioned this year. Of this total, $62,687,500 is to be devoted to the construction of a canal from the Rhine to the Weser, including the canalization of the Lippe, and various other accessory works. The balance is to be expended upon the construction of a large canal for barges between Berlin and Stettin, the improvement of the waterway between the Oder and the Vistula, and the canalization of part of the Oder. In France the modernization of existing, and the construction of new, canals will absorb $41,200,000. The new works include the Canal du Nord, one from Cette to the Rhone, and another from Marseilles to the Rhone. A similar development is being carried out in Belgium, Austria-Hungary, and the Netherlands, for which large sums have been appropriated by the governments.

Owing to the success that has attended the inauguration of the steamship service with the vessel "Coya" on Lake Titicaca in Peru, the highest navigable sheet of water in the world, another and much larger boat "Inca" is now in course of erection upon the shores of the lake. This latest acquisition is 220 feet in length by 30 feet beam and 14 feet draft, of 550 tons displacement, and propelled by twin-screw engines developing 1,000 I. H. P., capable of giving a speed of 12 knots. The vessel was erected in England, complete in every detail, and was then dismantled, every section being packed and carefully numbered, and shipped in 3,000 cases to the port of Mollendo. From the seaport the parts were conveyed to the shores of the lake by railroad—a distance of 150 miles, and involving a climb of over 12,000 feet. The "Inca" is modern in every respect, being complete with elaborate passenger accommodation, electric lighting, and steam heating. There is accommodation for 24 passengers and every possible arrangement and facility for working freight.

At the last annual meeting of the Gas Association known as the Markischer Verein at Berlin, two interesting papers were read by Messrs. Pfudel, of Charlottenburg, and Bremer, of Berlin, concerning the replacing of cast-iron by wrought-iron pipes in the Berlin system. The cast-iron pipes, owing to the frequent breaks which occurred, gave rise to serious accidents, and they were then replaced by wrought-iron pipes without, however, taking the necessary precautions against rusting. At the end of a few years the pipes were entirely eaten through, and in their place was found an envelope which was mostly made up of rust. Then the company tried protecting the pipes by a coating formed of a mixture of tar, sand, lime, powdered clay, and pitch. A very good result was obtained with this coating, and it is found that pipes which have been buried for twelve years are perfectly preserved. The municipality of Berlin, after the disastrous explosion which took place in Handelstrasse, had the proprietors replace all the cast-iron branch pipes by the new system, so that soon there will be little danger of explosion.

THE SIZE OF MOLECULES.

By the term molecule the smallest possible particle of a chemical substance is understood. For example, if a piece of cane sugar is broken into smaller and smaller fragments, a point is finally reached beyond which the subdivision cannot be carried without pro-

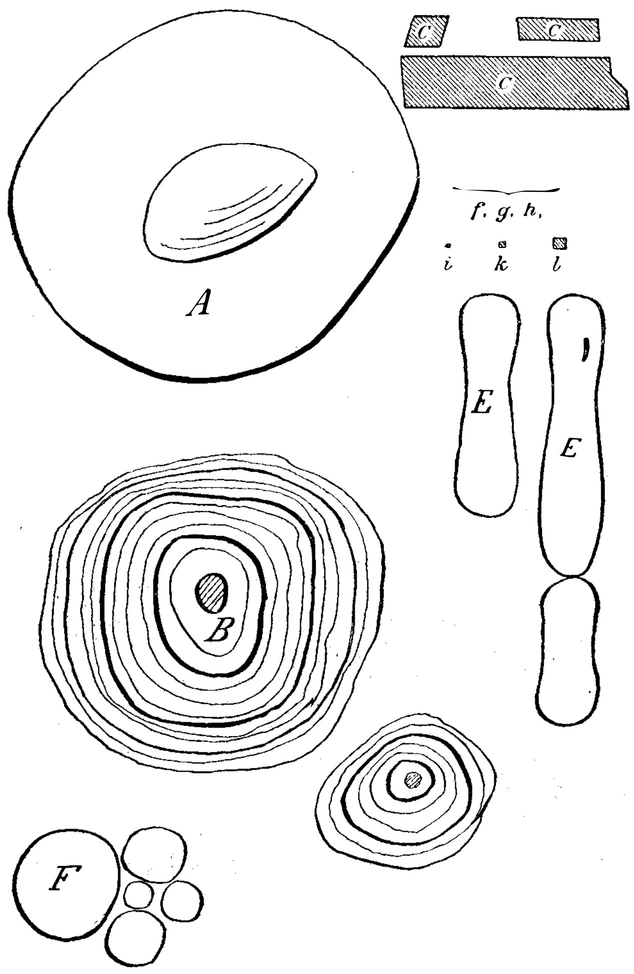


Fig. 1.—MAGNIFIED TEN THOUSAND TIMES.

A. Human blood corpuscle. *B.* Rice starch grain. *C.* Kaolin suspended in water. *E, F.* Bacteria. *f, g, h.* Particles of a colloidal solution of gold. *i, k, l.* Particles of a gold solution in the act of precipitation.

ducing something different from cane sugar. At this point we have reached the cane-sugar molecule.

Now, molecules are composed of atoms, which are the smallest possible particles of the chemical elements, and the dimensions of molecules vary greatly according to the number and character of the atoms of which they consist. The hydrogen molecule is a very small one, for it is composed of only two atoms of hydrogen. The molecule of cane sugar is comparatively large, containing 12 atoms of carbon, 22 of hydrogen and 11 of oxygen. But there are molecules of much greater size. The molecule of albumen is believed to contain nearly 1,000 atoms.

The subdivision of a lump of sugar, described above, is purely hypothetical, but many substances can be so divided very easily by dissolving them in water or

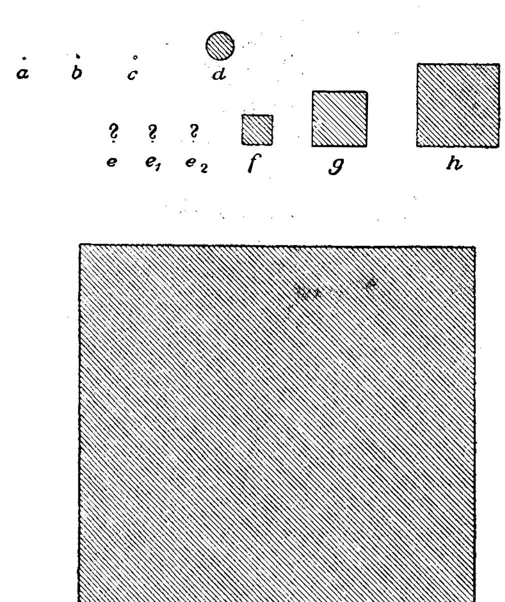


Fig. 2.—MAGNIFIED ONE MILLION TIMES.

a. Molecule of water. *b.* Molecule of alcohol. *c.* Molecule of chloroform. *d.* Molecule of soluble starch. *e-h.* Particles of colloidal solution of gold. *i.* Particle of gold in the act of precipitation.

some other liquid. In solution they are resolved either into separate molecules, as is the case with cane-sugar, or into larger or smaller groups of molecules. In the case of substances with very complex molecules especially, it must not be supposed that all the particles in the solution are equal in size; on the contrary, there are many reasons for believing that the groups of molecules are in various stages of disintegration.

The "ultra microscope," invented by Siedentopf and Zsigmondy, has made it possible to detect, in a solution, solid particles of a diameter of 4 millionths of a millimeter. (The limit of the best microscopes is 75 times as great, or 3 ten-thousandths of a millimeter.) This new optical instrument has brought the largest molecules, such as those of albumen and soluble starch, into the realm of visibility. The accompanying diagrams, from a recent publication* of Dr. Zsigmondy, may serve to give a vague idea of the dimensions of this ultramicroscopic world. If one of the largest of molecules, that of soluble starch, could be actually magnified 10,000 times in every direction, so that its volume would be multiplied 1,000,000,000,000, it would still be smaller than a pea. One of the five million corpuscles which are contained in a cubic centimeter of blood would, if enlarged in the same proportion, fill a large room, for its diameter would measure six meters.

In the Scientific American of November 11, 1905, some account was given of inorganic colloidal solutions, which consist of metals and other insoluble substances, in a state of extremely fine subdivision, held in suspension by water or other liquids. Zsigmondy has studied one of these solutions, colloidal gold, with especial care and has found that the suspended particles of gold differ very greatly in size.—Dr. Bechhold in Umschau.

The Current Supplement.

The current Supplement, No. 1572, opens with a description of some new bogie transport cars which were especially constructed to transport traction engines and motor-driven plows. Excellent illustrations accompany the article. Rear-Admiral George Melville's splendid paper on liquid fuel for naval and marine uses is concluded. For experimental purposes it is often desirable to have at hand an alternating current of low voltage. To secure this from a line circuit a transformer is necessary. Edmund S. Smith describes a small transformer that any one at all familiar with tools can easily build. The total cost of materials will not exceed $3.50, while the only machine tool necessary is a small drill. T. R. Hopper writes on some simple experiments with currents of high frequency. The general question of solution has always been of importance to the metallurgist. J. H. Stansbie gives his views on the solution of solids and solid solutions in a way that cannot but be of help to metallurgists. F. M. Feldhaus gives an illustrated description of some old inventions. Among these may be mentioned a very early magic lantern, a lamp with a glass chimney invented in 1500; Leonardo da Vinci's parachute; a very modern-looking diving suit, dated 1500; a diving bell attributed to Alexander the Great; a paddlewheel boat of 1430, a turbine which bears the date 1575, and a rapid-fire gun which goes back to the fourteenth century. How natural and artificial patinas are produced is told by B. Setleg. The practice of the cyanide process of gold extraction presents us with several new and interesting aspects of the problem of solution. These Mr. G. F. Beilby has considered in an article that bears the title "Gold Molecules in Solution." "Recent Foreign Methods for the Production of Celluloid and Similar Substances" is the title of an article which has been compiled and translated from French, German, and Italian periodicals. Alexander W. Roberts presents graphically some idea of the sun's distance.

A New Sweet Compound.

A new compound described by Dr. T. Gigli has appeared in the European chemical trade which is designed to imitate saccharine. It is known as "banana essence." The taste of this syrup liquid is at first caustic and then bitter, but soon after very sweet. Its specific gravity is 1.188 at 20 deg. C., and it gives an acid reaction. Analysis shows it to contain 54 per cent of saccharine in combination with a base analogous to pyridine. Heated on platinum foil it gives white fumes, then burns with a bright flame, leaving a thin layer of carbon. When the latter is burned, the ash is negligible. The syrup gives a precipitate with Nessler's liquid and most of the alkaloid reagents. Adding dilute mineral acids we can separate the saccharine as a white crystalline precipitate, and ether dissolves it again. By evaporating the ether solution we have white crystals which melt about 225 deg. C. The author tried to prepare a solution of saccharine in pyridine, but did not obtain a product identical with the above.

M. Poincaré, the learned French mathematician and member of the Academy of Sciences, has carried off the John-Boulyai Hungarian prize of 10,000 crowns, or a little over $2,000. This is the first award of the prize which is granted every five years to the author of the most notable mathematical work produced during that period.

* Zur Erkenntniss der Kolloide. Jena, 1905, G. Fischer.

Correspondence.

Strange Growth of a Tree.

To the Editor of the SCIENTIFIC AMERICAN:

I would like to inquire, through the columns of your paper, if any of the readers of your most valuable publication has ever seen or heard of a branch of any kind of tree starting and growing up through the hollow of the mother tree. If so, I would like to hear from them, either through the columns of your paper or otherwise. I get the paper here. I have a piece of redwood, that I secured at Boulder Creek last summer, that started and grew right in and through the hollow of the mother redwood tree. The piece is about four feet long, and dropped out of the hollow of the log at the mill when the saw cut it free, the remainder being split by the saw and spoiled. JOHN DOUGLAS.

Watsonville, Cal., January 17, 1906.

[While it seems not at all impossible that a shoot of a tree should come up through the hollow trunk of the same tree, it might also be possible that the shoot originated from a seed dropped into the moist, hollow trunk and germinated there, forming a second tree growing within the first. It is very common that a small tree starts from another tree; it may be a different kind. The origin of the new tree is a seed from some fruit which was lodged in a decayed place in the old tree.—ED.]

Should Railroad Speeds be Decreased?

To the Editor of the SCIENTIFIC AMERICAN:

The contribution of Willard P. Gerrish in the issue of January 20, on "Safety on Railroads," has attracted my attention. I agree with Mr. Gerrish that the space interval for train operation is the only way to provide absolute safety, and it lies with the traveling public to determine whether they will railroad safely, or on chances, the latter choice being due to the present craze for fast riding—a craze that is far-reaching, affecting all classes of travel, from the boy on the bicycle to the Twentieth Century Limited. The former works hard to get there as fast as possible; the latter, the same. The officers of the company running this train, will tell you the public demands fast time and they have to meet competition, and the traveler has to stand in the breach. If he gets there safely, all well and good; if not, the company which is trying to supply his demand for fast time is called on to heal his wounds with greenbacks. Now if the public is responsible for this craze and its attending evils, why cannot we have, along with rate regulation, rate-of-speed regulation? We shall live just as long, and make as much money if we do not go from New York to Chicago in eighteen hours. The railroads will make more money in the long run, there will be less loss of life and valuable property. Now, Mr. Gerrish wants to make the long-suffering railroad use up its hard-earned surplus on signals, which he says are not capable of producing infallibility of operation, and as a further protection he wants automatic stops. My experience with the latter is that it is all right in ordinary conditions—for instance, they may be all right in the Subway where ice and snow are unknown; also, in "the good old summer time." But just at the time they are most needed, in a blinding snow storm, they are not capable of doing business, and the engineman, with his bunch of frailties, is the one to fill the gap. Some years since, a prominent road running out of Chicago tried a stop that would even shut off the steam, besides applying the brakes, if the engineman ran signals; but they either did not have a good thing, or did not know a good thing when they saw it. I would again say, let us have speed-rate regulation, backed by law, allowing no train to run above forty miles per hour, and I will show you reasonably safe railroading. J. V. N. CHENEY,

Division 40, B. of L. E.

So. Portland, Me., January 26, 1906.

Teaching of Science in Schools.

To the Editor of the SCIENTIFIC AMERICAN:

The letters that have recently appeared in your paper regarding the teaching of science in the schools are not only interesting, but the discussion is timely and important. The condition described in Mr. Perkins's first letter (October 21)—that of several men presenting themselves for examination for which they were hopelessly ill fitted—seems to harmonize but too well with what we might easily expect as the result of many elementary science courses in high schools. We could pass this by perhaps with a smile, were it not for the deep conviction that the student has not only failed to correctly estimate the purpose of his course, but has gained from it very little of anything that will compensate for the time and energy spent.

The general impression received from a survey of courses and results in secondary school work in physics is that there is a great deal of hit-or-miss work being done. This seems to be due not to any lack of care on the part of the instructors, who as a class are earnest workers, but rather to a desire to accomplish too much—and that coupled with a vague grasp on methods not always well understood. For example, the physics course is often given complete in one year. The pupil is perhaps getting his first insight into even the most elementary phases of the subject; yet he is given apparatus and set experiments to perform, often with purposely little explanation, and then expected to be ready for college work at the end of the year. We are not astonished that the average pupil gets so little out of his year's course in physics. The wonder is rather that this sort of procedure has so strong a hold upon secondary school work. In a few of our better schools the problem of science teaching is being solved in a manner which seems to be distinctly a step forward. Physics is made the chief (sometimes the only) science subject, and it is offered in two years. During the first year a popular plan is followed, while the work for the second year is college preparatory. Each course is complete in itself, though the first is generally required, whereas the second is optional. The pupil gets his general survey of the subject the first year, and comes to his college preparatory course with the single purpose, and hence the more time, to master fundamental principles—not in the vague hope of escaping some of his college physics, but with the definite object of getting ready for it. Thus the student who looks ahead to college work and the one who wants simply a clearer understanding of common phenomena are served, each to his needs. In an increasing number of schools physical science is being taught in the grammar and sub-grammar grades, not playfully, but so well that the pupil may come to his high school course with a good foundation for work of a college preparatory nature.

There seems to be a growing appreciation of the value of science study as a training in accurate thinking. Moreover, in these days when the startling results of investigation are so closely woven into our daily activities, it is deplorable that the principles underlying these phenomena are not taught in the schools in a manner which shall arouse interest and make the study profitable. This can hardly be done in a course of one year, with pupils who lack previous instruction in the subjects, if the work is governed by the necessity of fitting for college examinations at the same time. In whatever school the subject of physics is first taken up seriously, the study could be profitably directed toward an understanding of those principles that are applied to so many things right at hand, and the hope of passing college examinations at the end of one year should not be allowed to confound this good work. LOTHROP D. HIGGINS.

Danbury, Conn., January 17, 1906.

The Lessons Taught by Parachute Descents.

To the Editor of the SCIENTIFIC AMERICAN:

In 1892 I became dissatisfied with the parachute then in general use, because of its unpleasant habit of diving, plunging, and oscillating. I attempted to do away with these objectionable features, and commenced a series of experiments. I have made in all two hundred and fifty-four parachute descents. Some of the results of these experiments follow. I first tried various alterations in a parachute which I had been using for some time, and which would come down slowly and steadily one day, permitting me to land with the ease of a bird, only to be followed the next day by such violent pitching and swinging (under apparently the same weather conditions) that to land without injury became a matter of difficulty.

I raised the center of gravity from a point 20½ feet below the supporting surface, to 19 feet, then to 18, 17, 16, and lastly to 15 feet, before any decided results were noticed. Here the speed of descent, which had been gradually increasing, became very rapid, due, I believe, to the shortness of the ropes and to a consequent prevention of a wider spread of cloth, thus reducing the diameter of the supporting surface. One would naturally expect oscillations to become more frequent with the center of gravity at this short distance below the supporting surface, yet I found them occurring less frequently than they had been doing at 20½ feet. I then lowered the center of gravity to a point 22 feet below the supporting surface, when the speed of descent again became normal (decreased), oscillations remaining. However, I persisted in dropping the center of gravity to 23 feet, 24, and finally to 25 feet. At this last point no increase in the speed of descent occurred, and the oscillations were fewer in number, but followed by so great an increase in their violence, that the difficulty of landing reached the danger point, and induced me to return the center of gravity to a point 20½ feet below the supporting surface, where I left it. This series of experiments convinced me that the mere raising or lowering of the center of gravity (alone) will not produce stability. I now reduced the area of the cloth (supporting surface) and first removed 68 square feet. This failed to produce an increase in speed of descent, surprising as it may seem. I continued to make reductions of area until I had removed 105 square feet of cloth. The last cut was made after some hesitation, as I feared the speed of descent would increase very much. It did so, to an alarming extent, but this fault was partially compensated for by the ease with which the parachute could be guided, a fact that made it possible to avoid all obstacles in landing. I had sacrificed 105 square feet of supporting surface, leaving but 288 square feet. Yet I (who weighed 144 pounds) was able to land without any great inconvenience to myself. This feat would have been impossible had the oscillations continued, but they had disappeared, due no doubt to the increase of speed of descent. I now rebuilt this parachute by replacing the same amount of cloth that had been removed. I next tried what effect enlarging the opening in the top of the parachute would have. This opening is said to "prevent oscillations," by permitting the escapement of compressed air accumulating beneath the sustaining surface of the parachute. That air does accumulate under a parachute can be seen by the following experiment: Should the aeronaut fail to let go of the parachute immediately on landing, the expansion or other effect of this air accumulated in descent will cause the parachute to jump to one side or the other, jerking him off his feet. I never knew this experiment to fail. That the phenomenon is not due to a breeze is shown by its occurring when no perceptible wind is blowing. In my parachute this top opening was 8 inches in diameter. I increased the size to 9 inches, then to 10, 12, 13, 14, 15, and lastly to 16 inches, at which point oscillations disappeared entirely, and the speed of descent, which had been gradually increasing—as each additional inch was added to the size of opening—now reached a point beyond which I felt I could not go with safety.

A reference to all of the foregoing experiments will show that, to secure the stability and control of the parachute (aeroplane) I was compelled to sacrifice safety, by adding to the speed of descent. (Notice the heavier than air principle here.) The greater the speed the fewer the oscillations, and the less effect any prevailing breeze had to cause a horizontal drifting, and the easier the parachute was to guide.

Now, apply these facts to an aeroplane, and we see at once that a flying machine constructed on the aeroplane system is an exceedingly difficult thing to control. Add to this the desire of the inexperienced operator to avoid (what he calls) great heights, and his usual attempts to glide near the surface of the earth (where the wind always comes in puffs) and we arrive at the real cause of failures and accidents. With the aeroplane so close to the ground, the slightest dive or other variation in its course is very apt to result seriously, because the operator will be unable to control the machine quickly enough to avoid disaster. A greater height would have added to the safety by giving him more time to control its movements. What does a man care how much a parachute (aeroplane) tosses about at a height of five hundred feet or more above the earth? At no time need he feel any anxiety, nor is it necessary to make an attempt to control it until he is much nearer the ground. The faults of the aeroplane flying machine may be many, but why add to them by placing it in the hands of an inexperienced person for operation? More than one good machine has been discarded or remodeled, when the operator was the failure and not the aeroplane. That an intelligent attempt to guide or control some one or more of the various movements of a parachute (aeroplane) is productive of good results cannot be denied; and on nearing the earth, and just before landing, I always try to stop oscillations if possible. If not, I still have another method to try. For instance, we will say the wind is blowing from the west; my parachute would then be drifting east. Now, just before landing, I pull down and hold down the west side of parachute. This will cause it to swerve or dive west, or right against the wind, and it will continue this westward movement until the wind pressure stops further progress in that direction, when of course the eastward drifting would again commence. If, however, I have timed my pulling-down movement just right (and practice has enabled me to do so with some degree of certainty) my parachute will permit me to strike the ground just before the eastward drifting again takes place, or at that instant of time when the parachute has no horizontal motion. I also wish to say that, contrary to prevailing opinion, parachutes have always given me the most trouble by oscillating, diving, and pitching on a day when little or no wind was perceptible. With a fresh breeze prevailing I have experienced no difficulty from these causes. J. J. COUGHLIN.

Versailles, Ohio, January 18, 1906.

Preparation of Mercurial Water. This is prepared with 10 parts of quicksilver, and 11 parts of nitric acid of the specific gravity 1.33 poured on it with the necessary precaution. It is allowed to repose until all the mercury is dissolved, then shaken vigorously, and 540 parts of water added.—Journal de l'Orfeverie.

MAKING VALENTINES BY THE MILLION.

Few people realize what a large industry has grown out of the custom of giving valentines on the 14th of February each year. The valentine idea seems to have originated in England, and is now practised by English-speaking people the world over. Germany, although it does not recognize the day, supplies many of the cards and novelties used in the United States. Of late years America has taken the lead in the valentine industry. Now we not only supply our own market, but export large quantities of valentines to all parts of the world. The largest valentine supply house in the world is located in this city, and here a large force is busy the year round working to meet the enormous demands.

The accompanying photographs illustrate the various processes followed in the manufacture of the different kinds of valentines. There are three principal types of valentines, namely, the comic, the old-fashioned lace, and the "novelty" valentines, the latter being the most expensive. The comics, which seem to be by far the most popular, are photo-engraved and printed in color in the usual manner, and therefore need no special comment. Special machines, however, are required in the production of lace valentines, while the novelty valentines are largely made by hand. One of our illustrations shows the machine which makes the paper lace. It consists of two rolls, one a die, and the other a matrix of the desired design. A wide paper ribbon passes between the rolls, and is cut by them. A brush bears against the matrix roll, cleaning off any adhering bits of paper, and another brush which bears against the ribbon removes the cuttings from the lace. The paper is chalked before entering the rolls, to prevent the lace from sticking to them and tearing. This lace paper is fastened with paper hinges to embossed cards. The hinges are made by a small hand-operated machine, which creases long strips of paper by folding them in and out like camera bellows, and from these strips the hinges are cut off as desired. The cards to which the lace patterns are attached are printed in large sheets with a suitable design, after which they are embossed. The embossed sheets are now passed on to the folding table, where they are folded in sets of three, and then fed into the cutting machine. This machine is provided with cutters of various design, which cut out the cards with scalloped edges. The hinged lace frames are now glued onto these cards, thus forming the familiar old-fashioned lace valentines, which still find favor with a large portion of the public, and refuse to be displaced by the more modern designs. Of the latter, one of the simplest consists of a card with various celluloid ornaments attached thereto. The ornaments are cut out by hand with a punch and maul. The ornaments are then attached to the cards by means of a simple riveting machine, which is illustrated in one of the engravings. The small brass rivets are carried in a cup at the top of the machine, and are fed down into a channel by the notched wheel which may be seen near the upper end of the machine. At the bottom of the channel is an escapement which, at each operation of the machine, releases a rivet and lets it drop down under the riveting hammer. Valentines of this sort can thus be very cheaply made.

The more expensive novelty valentines are made up with silk and satin puffs and bows of ribbon, which must be applied by hand to the cards. The only machine work done on these valentines is the printing of the colored design and the blocking out of the cards. The rapidity and neatness with which the puffs and shirred borders of the various designs are made is remarkable. In making a heart, for instance, hot glue is lightly applied to the card along the outline of the heart. The puff is then made from a semicircle of silk, the edges being gathered as they are pressed into the glue by drawing and puckering them with the

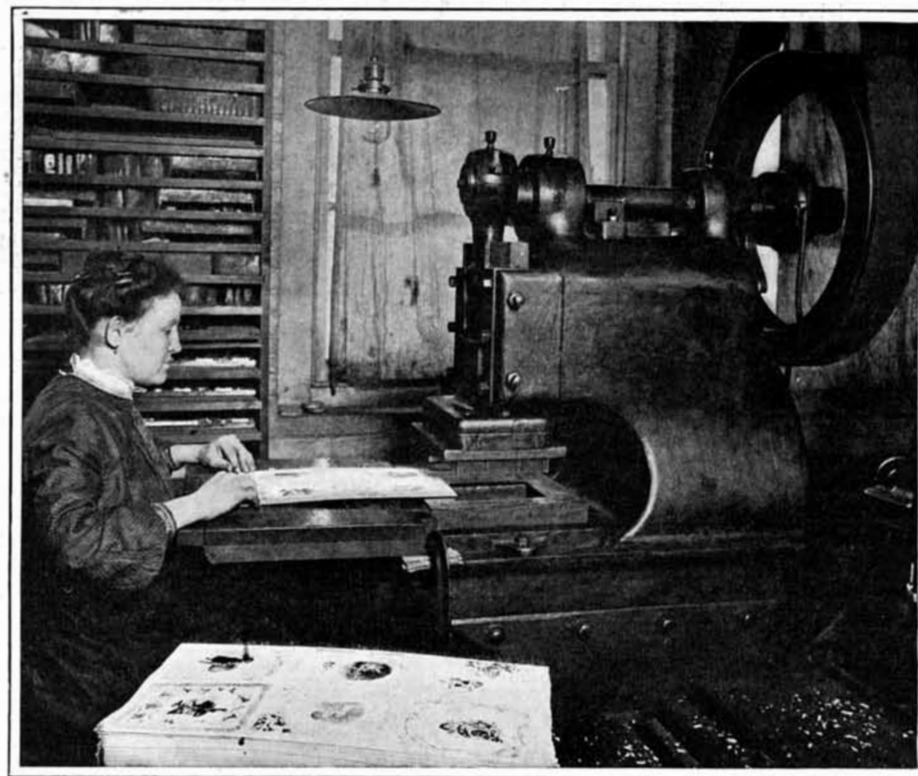
Making up the Silk and Satin Novelty Valentines.

Getting up Designs for Next Year's Trade.

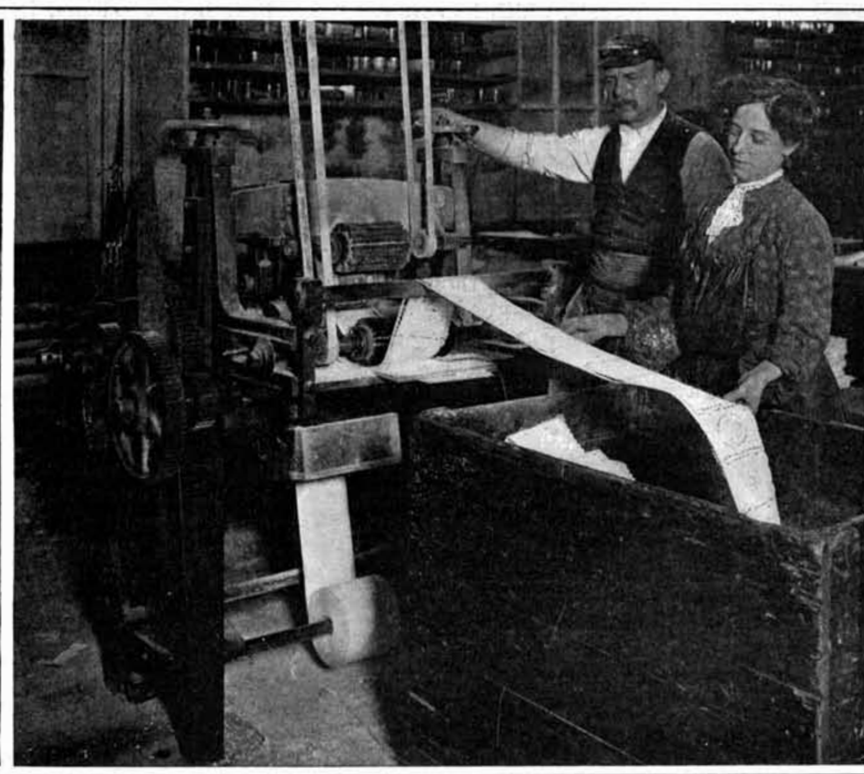
Riveting on the Celluloid Ornaments.

Correcting a Proof Sheet of Comics.

The Embossing Machine.



Cutting Out the Cards with Scalloped Edges.



The Lace-Making Machine.

MAKING VALENTINES BY THE MILLION.

fingernail. The borders are made of two pieces of cardboard cut to the proper curve and covered with colored silk, which is lapped over the cardboard and glued to the under side. This silk, also, is gathered as the edges are glued down, and the border pieces are then glued over the edges of the puff. In a similar manner many apparently intricate designs are very simply made.

Some of the valentine designs are carried in stock, from year to year, but each season demands its innovations, and expert designers are constantly at work endeavoring to get up new designs to please the sentiment of the lovelorn, as well as to touch the risibles of the practical joker.

THE TOTAL SOLAR ECLIPSE OF 1905.

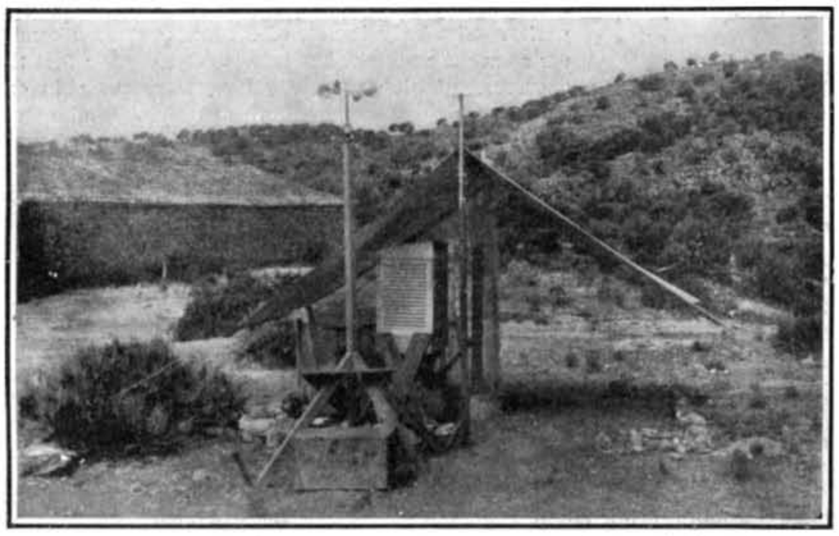
An eminent astronomer, a man who has led several eclipse expeditions, once remarked that he had never seen a total eclipse of the sun, because he had always been "too busy observing them." He meant exactly what he said. With a whole battery of telescopes, coelostats, and cameras under his command, for the perfect operation of which he was answerable, he saw no more of the majestic event occurring before his very eyes than a stoker on a transatlantic liner sees of the waters about him. It is not from the little army of men who composed the nine expeditions sent out from this country and the many more who were sent strip that cannot possibly be more than 167 miles wide, rarely reaches 140, and is usually between 50 and 100. Furthermore, he is confined to dry land, because a swaying ship is too unsteady a platform for astronomical instruments. Moreover, it is safe to say that any astronomer, watching quietly beneath his domestic dome, and having the good fortune to witness a single total eclipse from its convenient shelter, would, speaking generally, sit there for more than three hundred years before another would darken the same landscape. The only one ever observed in New York city occurred in 1806, and London, in 1715, had not been visited by a total eclipse for six hundred years.

Although the sun rises and sets every day in the year and has risen and set for millions of years, we can safely say, without any attempt at epigrammatic pleasantry, that no one has ever seen it. The real sun is hidden forever from us by a series of outer layers or shells. To regard these shells as the sun itself would be very much like saying that our atmosphere is the earth. All that we know about the sun, the nucleus surrounded by these shells, is merely that it must be hotter than the fiercest furnace we ever built, and that it must amount to about nine-tenths of the total solid mass.

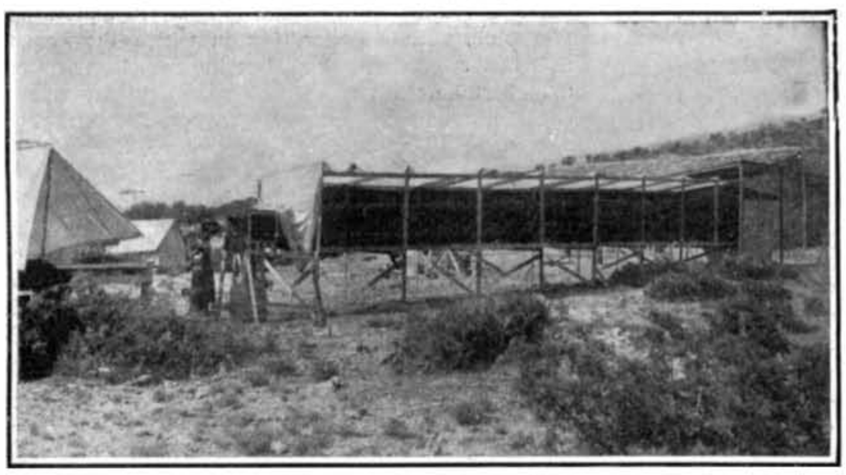
Of the outer shells we do know something. We know, for example, that the invisible core of the sun is surrounded by a layer of incandescent clouds known as with dancing, sunny sickles—minute images of the partially obscured sun. Gradually the solar disk is reduced to a thin silver bow; daylight fast gives place to an uncanny, dull, suffused glow. Faintly fringed with silver light, the moon appears what it actually is—an immense black ball hovering in the sky. From a mountain top the shadow of the moon may be seen sweeping across the landscape with almost terrifying rapidity, blotting out everything before it. The swiftness of motion and the intensity of the blue-black shadow give a feeling that something material is rushing over the earth. The corona flashes out in a weird aureole of pearly light.

The astronomical draftsmen whose duty it is to sketch the corona, bandage their eyes for fifteen minutes before the total phase, in order that they may be more keenly sensitive to every detail of the corona's ghostly beauty. Numerous photographs are also taken; but the sensitized plate, although it is affected by rays invisible to the eye, is incapable of adequately reproducing the delicate filaments of light that flash out for stupendous distances.

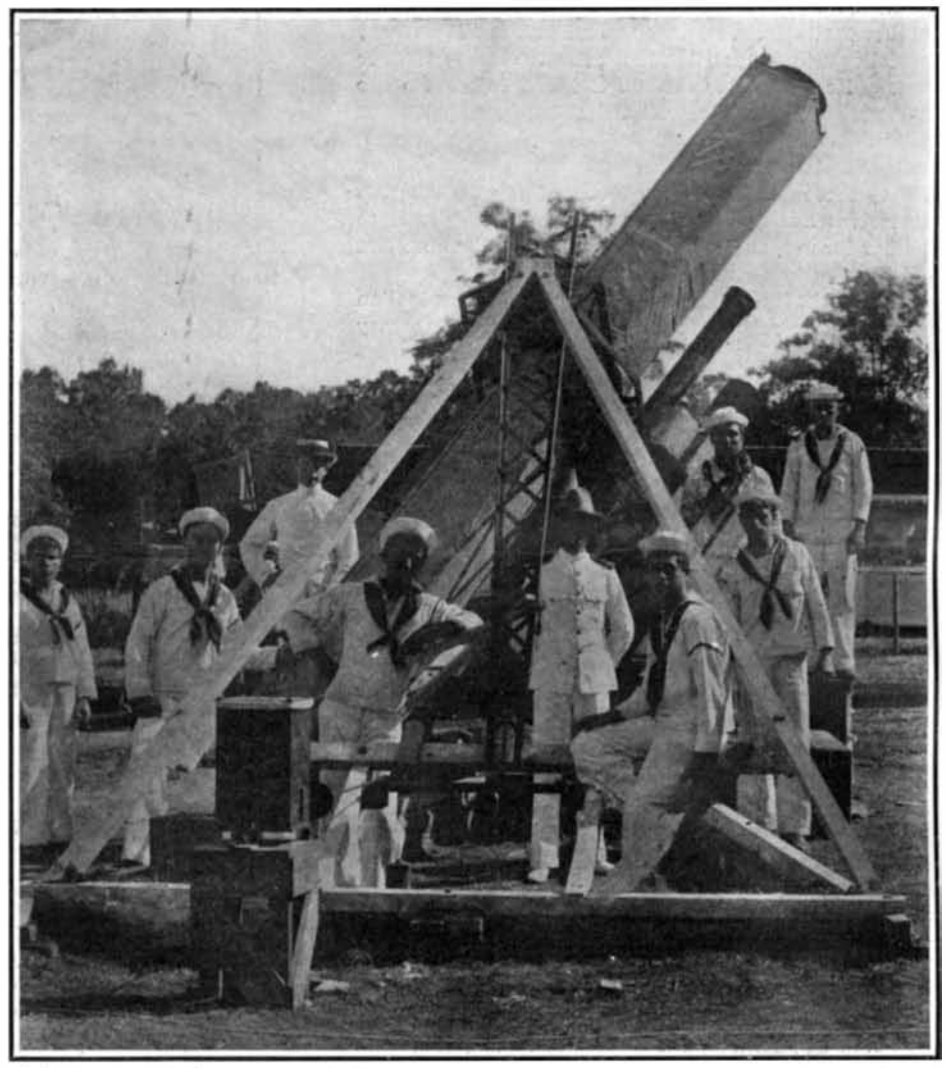
It seems not a very difficult feat to equip a party of men with a few instruments, set them down on a foreign shore for the observation of the corona and other solar phenomena. And yet the leader of such an expedition must have rare executive ability to systematize the work so that each man shall perform his duty



Prof. Bigelow's Meteorological Station at Puerta Coeli, Spain.



The 65-Foot Camera Coelostat and Spectrograph of the Puerta Coeli Station.



Polar Axis at Guelma, Algeria, and the Sailors from the "Minneapolis" Who Helped to Mount It.

THE TOTAL SOLAR ECLIPSE OF 1905.

out by European observatories from whom any stirring description of the eclipse of August 30, 1905, is to be expected, but rather from the thousands of unscientific spectators who had nothing to do but gaze at the sun through a piece of smoked glass and wait for the moment of first contact.

The eclipse of 1905 was visible on a comparatively narrow strip of the earth. Its path began at sunrise south of Hudson Bay in Canada, entered the Atlantic Ocean a short distance north of Newfoundland, diagonally crossed Spain, swept over the Mediterranean, traversed Algiers, Tunis and Egypt, and ended at sunset in southeastern Arabia. Along that path a shadow followed the moon as it swam between earth and the sun, exactly as your shadow follows you on a sunny street. When the shadow of the moon reached an astronomer stationed along the line that we have traced from Canada to Arabia, the sun was to him eclipsed. For good astronomical reasons a total eclipse can never last very much more than seven minutes, but last year's totality was not even as long as this, enduring at only one point for three minutes and forty-five seconds, and at others for but two and a half minutes. In an entire century it is not possible to spend more than eight days in solid observation of total solar eclipses. Lack of time is not the only limitation imposed on the eclipse observer. Although the path traced by the moon's shadow is several thousand miles long, he must take up his position in a narrow the photosphere, and consisting, in all probability, of countless granules having a diameter each of about 500 miles and floating in dark medium. The blazing disk that we call the sun is really the photosphere. After the photosphere comes a stratum 1,000 miles thick which was first discovered by Prof. Young and termed by him the "reversing layer," for the reason that it reverses the lines of the solar spectrum. Lying above the reversing layer for a depth of 5,000 miles is the chromosphere, stained blood-red by the crimson glare of hydrogen. Tongues of flame leap from this red mass often to a height of 10,000 miles, and occasionally to a height of 100,000 and more—tongues that may best be likened to the heaving billows and tossed spray of the sea. Just as the dark moon is apparently about to glide into the sun during a total eclipse, the red flames or prominences, as they are called, flare up vividly for several minutes before and after obscuration.

Beyond the photosphere, far beyond the prominences even, extending outward for a distance that may sometimes measure 350,000 miles, lies the diaphanous, pallid corona, visible only during a total eclipse and, therefore, the phenomenon which received most attention during the eclipse which occurred last August.

Words can hardly describe the grandeur of the corona. As the moon steals in between the sun and the earth, and the solar disk is gradually gnawed down to a diminishing crescent, the foliage of trees is flecked swiftly yet surely during the few minutes of totality.

Of the untiring energy lavished by the eclipse observer in operations of observing every phase of the sun's obscuration from the second that the moon touches the edge of the sun to the second when it clears the solar disk, some idea may be formed by recording here briefly the work accomplished by the United States Naval Observatory's expedition sent out by this government under the immediate charge of Rear-Admiral Colby M. Chester, superintendent of the United States Naval Observatory. Months before the darkening of the sun was to occur, the necessary instruments were mounted in the Naval Observatory grounds and tested with the utmost care to make sure of their efficiency. Then they were transported several thousand miles to the site where they were to be used, to three stations widely separated. The first station was located at Daroca, Spain; the second was at Puerta Coeli, 12 miles northwest of Valencia, Spain, and the third at Guelma, North Africa. An enumeration of the apparatus carried at great expense to these distant parts of the earth would read like a page from an instrument-maker's catalogue. At Daroca a 40-foot camera was used, especially designed to photograph the inner corona and its surroundings, besides a polar axis carrying a 14-foot camera, and a 36-inch camera equipped with a Dallmeyer lens and spectroscopes. At Puerta Coeli, Spain, the second station, Rear-Admiral Chester had mounted a polar axis carrying a camera with a

6-inch lens, of 104-inch focus, besides an immense 65-foot camera equipped with a cœlostat and triple lens. At the third station cameras and polar axes were likewise mounted, the instrumental equipment comprising a 40-foot camera, a polar axis on which a 15-foot camera was mounted, a concave grating spectrograph, a small concave grating, a low dispersion spectrograph, a chromospectrograph, four small prismatic polarigraphs for testing the polarity of the corona, and a 5-inch portable equatorial.

Eclipses come seldom, and last a few minutes at the most, for which reason the members of the expedition must be drilled until they are able to perform their duties with mechanical precision. Each man does his work in response to a signal. For weeks before the eclipse occurred, the battalion of men by whom the various instruments were to be handled, skilled though they were, were trained thoroughly. Day after day cameras, cœlostats, and spectroscopes were manipulated to obtain speed of operation and precision. Although the instruments were tested months before in the observatory grounds at Washington, the finer adjustments had to be made on the spot, and with the greatest care. The sun shifts his path each day, but lens and camera must be exactly in line for him at the all-important moment of eclipse, with clocks accurately rated to follow his declining while the moon's disk is passing his face. One instrument will compass the corona, another will catch the chromosphere; one waits but the instant after the sun's disappearance, another waits for that last second before his return; one follows the apparition throughout totality, another turns quite aside from the sun to his vicinity. No one of them, however, can wait till the eclipse has come and be aimed to it. It must be ready, with clocks so rated that there shall be no slips nor misconnections. Add to these difficulties the fact that the instruments themselves are made in one country and shipped to another for use, and we have some idea of the obstacles which an eclipse expedition must overcome.

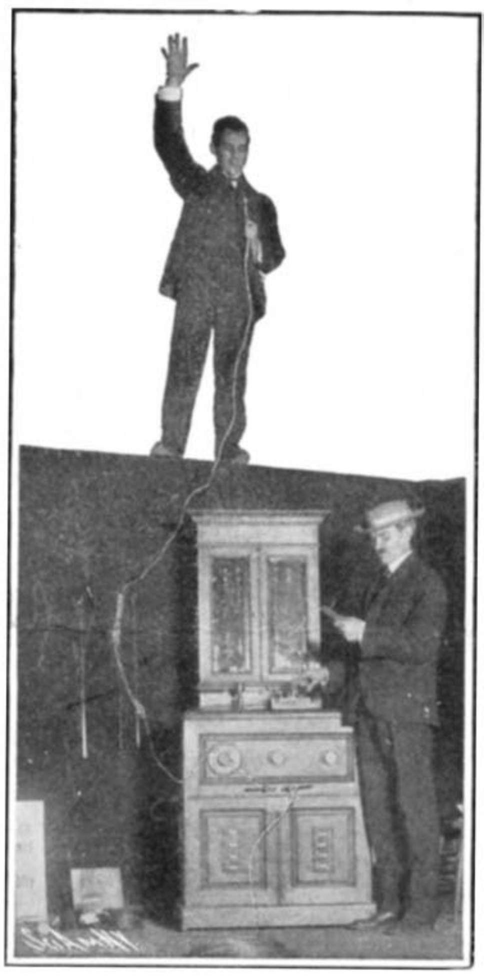
Among the many by-ways of eclipse investigation only remotely related to things astronomical we may mention minute attention to variations in electric conditions of the air; fluctuations in the magnetic currents of the earth, caused by the immediate interposition of the moon between us and the sun; a close watch upon the barometer and thermometer, to see what changes the temporary withdrawal of the sun's heat may have, especially on changes in the wind.

Regarding the definite results of an expedition, it is as yet too early to speak with authority. An immense mass of detailed observations was collected, which will, in all probability, serve to confirm many already existing theories and hypotheses. The photographs obtained are the finest secured by the observatory in any of its eclipse expeditions, and the affair, regarded as a whole, deserves to be considered the most successful of its kind. Spectrographic results of undoubted value were secured, as well as color observations, which will, when published, be of exceeding interest to students of the sun. The photographs do not show the long equatorial streamers as well as some others have done because the sun, at the time of its eclipse, was at the sun-spot maximum, which seems to affect the streamers greatly, mixing them up and producing a tangle, which, while exceedingly interesting, is not so spectacular as the long equatorial streamers seen in photos of the sun when an eclipse has taken place near a sun-spot minimum. It will take a minimum of one year, and very likely two or three times as long, to reduce all the observations, study all the negatives and make public the results. Expeditions of that character are designed to get all the available data possible; totality lasts but a short time and there is all the time needed afterward to study the results. But an impatient public usually wants to be told something definite and remarkable a week afterward, and to that public these few words of explanation are addressed. Astronomers do not get up eclipse expeditions with the idea of making startling discoveries, nor do they expect them. There is always the chance of something being learned which will throw important light on that most important astronomical subject, the sun; but it is not looked for, as a definite object is sought. Rather are these expeditions made up to take advantage of the opportunities Nature offers us to investigate the sun with the hope that, by a persistent accumulation of data, some laws may be deduced which will assist us in fathoming other problems of astronomy, as well as the certainty that nothing but benefit has ever come to science from the painstaking and patient research into difficult and often obscure places of nature, of which the sun and stellar space are two.

The observations at the eclipse stations, taken in conjunction with those others which were made, would seem to indicate that the "eclipse cyclone," the name given to the atmospheric disturbance supposed to be caused by an eclipse, does not exist except in the imagination. The temperature dropped less than ten degrees during totality, a very small amount compared to the popular conception, and the barometer was not affected at all. There was a ten per cent rise in humidity during the eclipse, but no other disturbance of note. It should be understood that the temperature did not actually drop ten degrees in the time of totality but that amount of drop was caused by the eclipse, the drop lagging ten to fifteen minutes behind the shadow. The same is true of the humidity.

The study of the photographs of the eclipse will include measurements, the making of drawings, comparison with other photographs and drawings, made by other expeditions at this time and expeditions at previous eclipses, production of colored charts, etc. The entire force of the expedition is enthusiastic over the success of the observations and photographs and believes that much of value to science will mark the eclipse of 1905 as one of the best observed and most thoroughly studied and, consequently, one of the most interesting and instructive eclipses of modern times.

Eclipses only rarely bring discoveries of a sensational nature. In 1868 Janssen and Lockyer found, independently, that the blood-red protuberances heretofore seen only during the moments of totality could be followed by a properly adjusted spectroscope after the eclipse was over. Still, they exhibit marked differences when viewed at totality and in full sunlight, so that their study is still a part of complete eclipse programmes. Other marked results of these pregnant but fleeting moments have been Prof. Young's discovery in 1869 of a material termed coronium; of the same astronomer's discovery of the "reversing layer" in 1870; of enormously extended coronal streamers in 1878 by Prof. Langley, and Prof. Deslandre's discovery in 1893 that the corona rotates with the sun. All these were in a way spectacular discoveries, made possible by the happening of eclipses. But, generally, expeditions throw but a little more light on some large solar problem, the whole to be solved only after repeated attacks through many eagerly seized moments of eclipse.



USING THE HUMAN BODY FOR SENDING A WIRELESS MESSAGE BY THE DE FOREST SYSTEM WITH THE ASSISTANCE OF DR. OVINGTON'S MACHINE. IN THIS EXPERIMENT 200,000 VOLTS OF HIGH FREQUENCY CURRENT ARE PASSED THROUGH THE HUMAN BODY, WHICH SERVES AS A MAST.

With the fungi, exact studies may be made upon the influence of the different nutrients on the general form and upon the production of conidia, etc. It has been found, for instance, that, in the absence of potassium, *Sterigmatocytis niger* may produce no conidia or very curious modifications of the conidiophores. By far the most interesting problems with relation to the mineral nutrients are those which have to do with the rôles of these elements in metabolism. The effect of the lack of one or another element is made manifest by some general macroscopic change, and sooner or later, by disturbing pathological changes and subsequent death. It is reported, for example, that the absence of iron prevents the development of a healthy green color, and a scarcity of potassium is made evident, especially in reduced photosynthesis.

THE HUMAN BODY AS A WIRELESS TELEGRAPH TRANSMITTER AND RECEIVER.

Everyone knows that the human body is a conductor of electricity, but that it may be employed as a radiator and antenna instead of the usual aerial in wireless telegraphy may not be so well known.

During the recent electrical show at the Madison Square Garden, a series of experiments was performed by Prof. Ovington, of Boston, Mass., with high-potential and high-frequency currents. One of these consisted of substituting the body of the lecturer's assistant for the usual vertical conductor used in sending wireless messages.

A reference to the illustration shows how the connections were made, the current from the machine passing through the assistant's body, from whence the energy was radiated as wireless waves in the ether. The messages were sent from this novel radiating arrangement in the small demonstration hall at the extreme western end of the building, and were received by a De Forest receptor set up and furnished with the usual wire antenna located in about the middle of the main auditorium.

The potential and frequency of the oscillations were very much in excess of those utilized in the commercial transmission of wireless telegrams and hence the waves radiated were exceedingly short.

It was Prof. Tommasini, of Geneva, who first demonstrated that the human body could be successfully substituted for an aerial of the same length and capacity. The body is not, of course, as good a conductor as are the metals, but this is offset by the fact that a current of high frequency penetrates the skin only a very small fraction of a millimeter. M. Emile Guarini, of Brussels, actually sent messages through space by connecting one human body to the positive side of a spark-gap, and another similarly connected to one terminal of the coherer.

German Army Autos.

The German army, which already has three battalions of telegraph operators and one of aeronauts, is to be provided in the near future with a volunteer corps of chauffeurs. At first it was proposed to establish an automobile post or station, but the project was abandoned on account of the great cost it would involve. The volunteer automobile corps is to be recruited from among the members of the German Automobile Club, and it is limited to the Prussian provinces and the states whose military contingent is under the direction of the Berlin authorities. The persons who wish to enter as volunteers are asked to apply to the Automobile Club, with a declaration in which they engage first to serve an unlimited time in case of war, second, to undertake three periods of maneuvers of ten days each, in the space of four years, and third, to carry out all the orders which are given them by the officer in command. On November 1 of each year the club communicates to the Minister of War the list of volunteers available during the following years, with their addresses and the necessary data as to machines, etc. The volunteers are required to wear a gray uniform while in service. Prince Henry of Prussia has been placed at the head of the corps.

Crossing the English Channel by Balloon.

A balloon of the English Aero Club left London February 4 and descended in safety at Bermouville, France, twenty miles inland. The entire time consumed from London to the place of descent was 4 hours and 10 minutes.

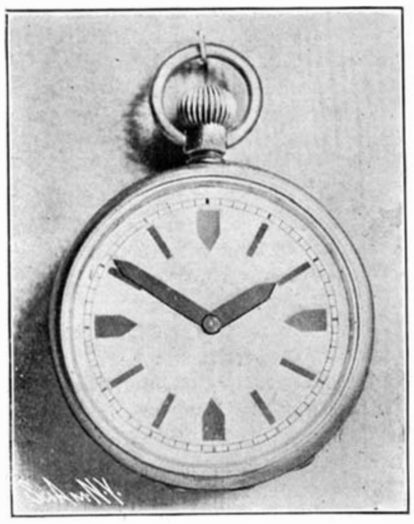
The occupants of the balloon were Messrs. Pollock and Dale, who are members of the Aero Club of the United Kingdom. The name of the balloon is the "Vivienne III."

A strong northwest gale was blowing during the passage across the Channel, which was made in an hour and three-quarters. Once the balloon ascended to 10,000 feet, where a snowstorm was encountered and the entire airship was incrusted with frost.

Lucerne possesses one of the most recent hydraulic plants which has been set in operation in Switzerland. It is used for lighting and power in the city. The hydraulic plant uses a 1,000-foot fall to run the turbines. The dynamo plant consists at present of four alternating current dynamos of 1,600 horse-power each, but the plant is to receive eight dynamos when it is fully completed. These machines have been furnished by the Swiss Oerlikon Company. Three-phase current at 6,000 volts is employed here and the machines run at 300 revolutions per minute. Part of the current is sent over a cable line to the town of Engelberg, which lies three miles off, but the greater part of the current goes to Lucerne over a high-tension line at 27,000 volts, the distance being 17 miles. From Lucerne a number of branch lines go out to different localities. For use within the city of Lucerne, the high tension of the line is lowered to 2,600 volts and the current is distributed in part by cables and part is converted into direct current for operating the tramway lines.

A NOVELTY IN WATCH DIALS.

Major-General Baden Powell, of Mafeking fame, and the author of more than one valuable handbook on military matters, is responsible for an invention illustrated herewith which scarcely needs description. It appeals alike to the short-sighted civilian and the soldier employed on night scouting. According to one of the most fashionable jewelers in London, a number of eminent military and naval officers have had the "B-P" dial adapted to their chronometers.



A NOVELTY IN WATCH DIALS.

A CURIOUS ARCHED TREE.

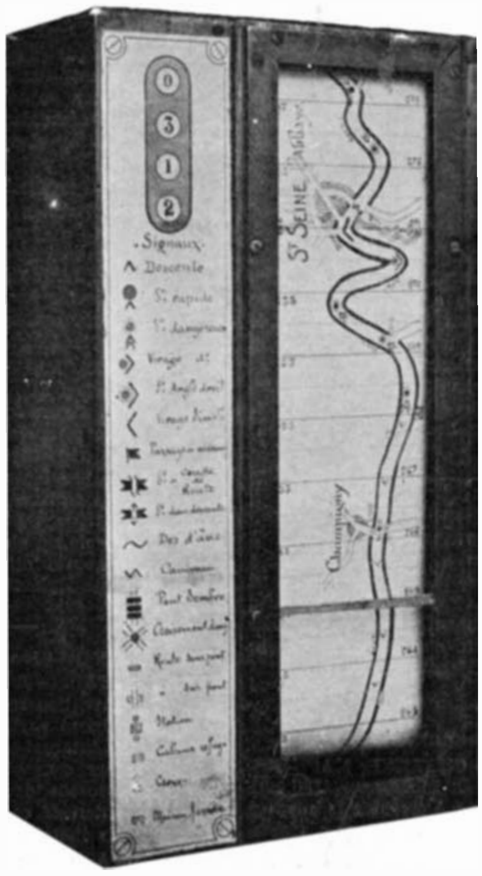
John S. Welter, of Upper Sandusky, Ohio, sends us the accompanying photograph of an oak tree which is a most striking natural growth. The tree is near the village of Wharton, Wyandotte County, Ohio. The roadway which it arches is forty feet wide. At the base the diameter of the tree measures two feet.

AN ARCHED TREE OVER AN OHIO ROAD.

THE "AUTO-CARTE."

AN INGENIOUS DEVICE FOR SHOWING THE LOCATION OF THE CAR AT ANY MOMENT.

The "Auto-Carte" is an ingenious little device which is mounted on the dashboard of the car, and which, by the unrolling of a band of paper, shows the exact position of the car upon the road at any moment. With the high speeds which are now used, sign-posts are becoming of little use, seeing that they cannot be read usually without slowing up. This is especially true when traveling at night. The "Auto-Carte" has been invented to provide for this case and it will no doubt be much appreciated, as it avoids the handling of maps and gives a sure indication of the road. The strip of paper has printed upon it a map of the road on a sufficiently large scale so that all the needed points can be indicated. It is unrolled automatically by a friction roller arrangement mounted beside the road wheel and connected by a flexible shaft and worm gear to the rollers upon which it is wound. The friction gear can be readily adjusted to suit the diameter of the car wheel should it wear down, and besides the apparatus can be adjusted if need be when passing by some well-known point, such as a town. By using this device the driver can see at just what part of the route the car is traveling, and he can read ahead for a distance of 5 miles, thus finding all the obstacles, turns, descents, etc., long before they are reached. One advantage lies in the fact that as the map is quite exact the driver is not obliged to ask the way, and this is an especially good point when passing through towns. The inventors pay attention to this latter point, and take care to indicate on the band the exact passage through the towns as much as possible. This point will be greatly appreciated. When traveling at night the "Auto-Carte" will prove a boon to chauffeurs, as it is always illuminated and enables them to travel with security at a higher speed than usual.



AN AUTOMOBILE ROAD INDICATOR. THE DEVICE TELLS THE CHAUFFEUR HIS EXACT LOCATION AT ANY MOMENT AND THE CHARACTER OF THE ROAD BEFORE HIM.

Bees, Insects, and Flowers.

It is a much contested question, whether insects in general and bees in particular are attracted by the brightness of flowers, or by their perfume. A few weeks ago M. Félix Plateau described at the Brussels Royal Academy the following case: If we place a mirror with a convenient inclination twenty or forty centimeters (from about seven to fourteen feet) from natural flowers, the insects that come and place themselves upon these flowers seem to pay no attention to the reflected images. The Belgian scientist thought himself authorized to conclude that it is not the sight of the flowers that attracts the insects.

M. Gaston Bonnier, who shares this opinion, has just communicated to the Académie des Sciences the result of observations showing, especially, how difficult it is to give a decision in so delicate a matter. When bees are busy in the afternoon collecting water upon the leaves of the aquatic plants, they do not touch the honey that we offer them upon those leaves, or upon floats of various colors. If, on the contrary, we make the experiment in the morning, the drops of honey are quickly carried away. The learned professor explains the matter by the "habitual" strictness with which bees obey their orders. When they are "commanded" to go for water, they would not allow themselves to gather any honey. In the morning, on the contrary, it is quite natural that the "explorer" bees sent reconnoitering to find a field of plunder hasten to describe to the swarms the honey which they find. What we know of the habits of bees renders pretty probable this ingenious interpretation.

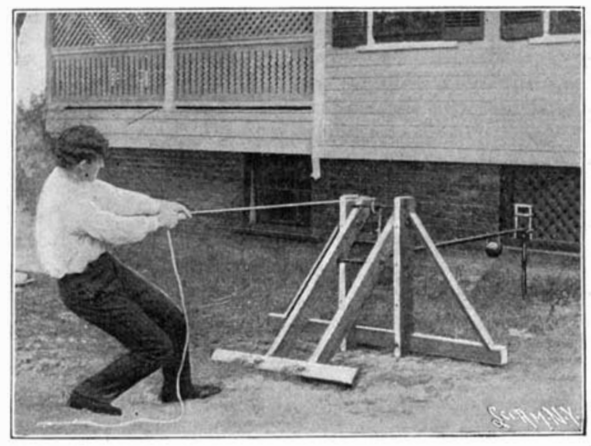
A SIMPLE DYNAMOMETER FOR SCHOOL GYMNASIUM TESTING.

BY THOMAS R. BAKER.

At a trial of pulling strength between two classes of college boys in a "tug of war," the boys grasping, at convenient distances apart, the halves of a strong rope, and the classes pulling against each other with the combined strength of the members of each, the question as to how much a boy could pull in such a contest of strength was naturally suggested. No answer was at hand, not even in the books on mechanics that were accessible, and no means were available for determining this pulling strength experimentally.

An accurate dynamometer is an expensive apparatus, and therefore not conveniently procurable for incidental testing of this kind; and as the cheap spring-balance form of the instrument could not be relied upon on account of its inaccuracy, I concluded to make a simple apparatus for pulling-strength testing involving the lever principle. The apparatus is shown in the accompanying cut. It is essentially a third-class lever working in a strong wooden frame with spreading legs, and somewhat like the trestle used by mechanics. The pulling force is the power, and it is exerted through a rope attached to the lever, and running over a pulley supported by the upper part of the frame, to enable the pulling to be done in a horizontal direction; the weight is an iron ball, movable along the long arm of the lever, to adapt the leverage to the strength of the puller; the fulcrum consists of two steel rings fixed in the inclined legs of the frame.

The form of support adapted to the working of a lever for making the tests was carefully determined by first making a model that would work satisfactorily. Two of the legs of the support are vertical and have a cross-piece, whose length is more than twice the width of the apparatus, bolted to their lower ends to serve for lateral bracing. The other two legs make an angle of about 45 degrees with the vertical ones, and their ends, which are let into the ground several inches, are made wedge-shape with the faces of the wedges toward the puller, and vertical so as to enable the ground to offer the greatest resistance to any tendency of the apparatus to move in the direction of the pulling. Outside lateral braces extend from the ends of the cross-piece to the upper ends of the vertical legs, and opposed to this bracing, to increase the rigidity of the apparatus, a piece of inch water-pipe with a connector on one end screwed on as far as it will go, is fitted between these legs; and the bracing is effected by unscrewing the connection.



A SIMPLE DYNAMOMETER.

The lever is a piece of inch water-pipe seven feet long, and to guide it in moving in a vertical plane, it has a short cross-piece of inch pipe screwed to the fulcrum end, giving this end the form of a T. The ends of a steel bar which passes through the cross-piece project from it, and are made with knife-edges to work against the inner side of the ring fulcrum. The iron ball used as the weight weighs 16 pounds. The resistance capacity of the lever varies from 50 to 210 pounds, and the arm is graduated to indicate differences of two pounds. The pulling rope is about three-fourths of an inch in diameter—a suitable size to be conveniently grasped by the puller.

The lever is adjusted to a horizontal position for pulling tests, and is controlled in its upward movement by a stop placed at the end, permitting it to rise only a few inches.

The lever was graduated by bringing the pulling rope, one end remaining attached to the lever, over a pulley fixed in the ceiling of the room, and attaching a board for a scale-pan to the other end; then using carefully weighed bricks in the scale pan to lift the lever weight, adding bricks as the leverage was increased by moving the weight outward. It was found, however, that the graduating could quite readily be done by means of an accurate steelyard.

To render the apparatus more readily transferable, the frame is put together with bolts, and the lever is made removable.

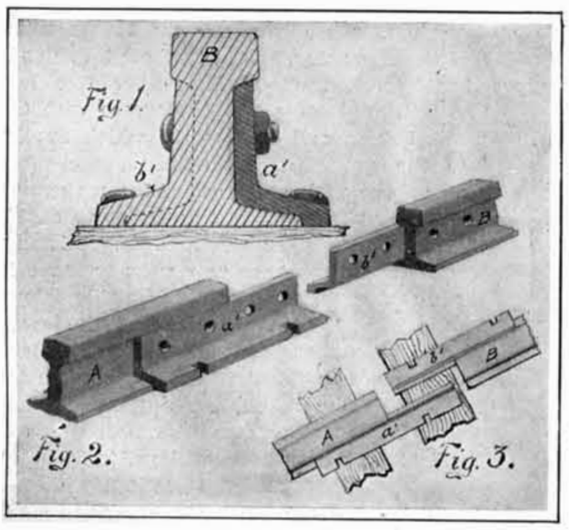
This apparatus has proved interesting and valuable, many of our students having used it to determine their pulling strength in pounds, to find out how much stronger in this respect one was than another, and to find who was the strongest among a crowd of boys making the tests. Moreover, the apparatus may serve a good purpose in gymnasium work as a strength developer. Indeed, it would seem to be a desirable apparatus for common gymnasium outfits, and on account of its easy construction and small cost it is readily procurable.

The number of pounds that could be pulled was, very naturally, found to depend greatly upon the foot resistance that could be secured, other things being equal. If the puller dug a hole in the ground with his heel, and pulled against this resistance, he could pull considerably more than he could simply against the resistance afforded by the level ground. Of the fifty or more boys who tested their pulling strength with the apparatus with ground heel-supports, their pulling varied from 125 to 210 pounds; and without these supports, from 35 to 50 pounds less was recorded upon the apparatus.

AN IMPROVED RAIL JOINT.

Pictured in the accompanying engraving is an improved rail joint, which has recently been invented by Messrs. H. Herden, S. E. Fitch, and J. H. Burgoyne, Jr., of Galeton, Pa. It is a well-known fact that a railway, as usually constructed, is very weak at the points where the rails are joined. This defect is much more apparent when the bolts become loose. The improvement here illustrated consists in welding splice bars to each end of a rail, but at opposite sides. The bars will thus form integral parts of the rail. When connecting two rails, *A* and *B*, their ends are joined in the usual manner, allowing space for expansion and contraction, and are then fastened with bolts passing through the splice bars *a' b'*. The rails *A* and *B* thus virtually overlap each other, the rail *B* being supported by the splice bar *b'* engaging the flange of the rail *A*, and the latter being similarly supported by the bar *a'* engaging the flange of the rail *B*.

After the splice bars are spiked down to the ties, they will keep the rails in proper alinement, even if no bolts are used, and the ends of the rails cannot be depressed when a wheel is passing over that part of the joint. The so-called "hammering" at the joints is thus prevented. It will be evident that this joint, since it can withstand a severe test without the use of bolts, will reduce to a minimum the strains on the bolts, and prevent their liability of coming loose. The improved joint admits of a short bar, and simplifies the work of track laying. A rail can be readily taken out of the track and reversed, or it can be used in connection with rails which are not equipped with this improvement, by employing loose splice bars.



AN IMPROVED RAIL JOINT.

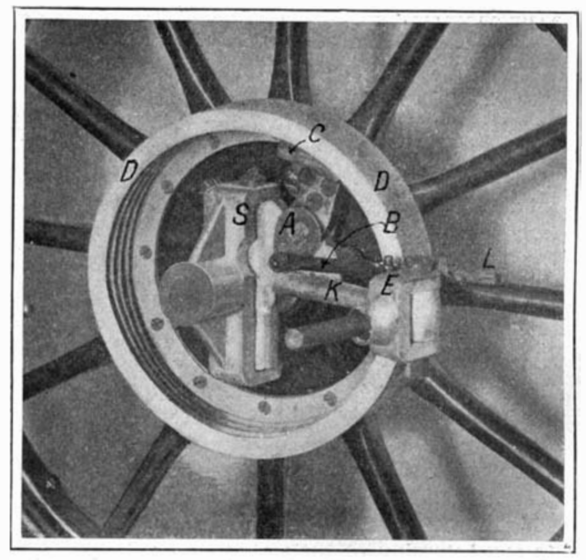
"Consider Her Ways."

Among the apparently useless evils of the world, the white man has always reckoned the white ant, the greedy devourer of everything vegetable and animal that comes in its way, making many a region unfit for human habitation, but now Dr. Arthur J. Hayes, who has recently visited Abyssinia with the surveying party sent out to set up the marks for gaging the annual rise of the Blue Nile, broaches another theory. He went through the Soudan to Lake Tsana, western Abyssinia, and returned to Egypt by the valley of the Athbara, and in his book, "The Source of the Blue Nile," he records his opinion that it is to the white ants that the mud spread over the Nile delta in the annual floods owes its wonderful fertility. He does not say that the ants supply all the mud that is deposited in the delta, but that its productive property is due to their work in the western borderland of Abyssinia. This discovery, if discovery it be, is as interesting as those of the value of the earthworm, and the possibility of inoculating land for the increase of a desired harvest. Perhaps the humble brown ant, and even the little black ant, are benefactors of the human race, and the mason wasps and ground spider have other uses than to cause naturalists to write delightful books.

WHEEL-BLOCKING SAFETY DEVICE FOR AUTOMOBILES.

Our illustration shows a novel device recently brought out by the Hayden Automatic and Equipment Company, for the purpose of blocking the wheels of an automobile should it start to descend a hill backward, owing to the brakes failing to hold. We illustrated a ratchet arrangement for this purpose in our recent Automobile Number. The present device can be applied to the front wheels of the machine, and hence it does not form any incumbrance that would interfere with the brakes.

As can be seen from the cut, the arrangement consists of a grooved drum, *D*, which is attached to the spokes of the wheel by means of screws. The movable member, *K*, of the steering knuckle, *S*, has a suitable bracket upon which is pivoted, at *A*, a cam arrangement, *C*, having grooves corresponding to the ridges in the drum. A rod, *B*, and a bell crank, *L*, are used for moving *C* forward toward the steering knuckle when it is desired to free the wheels so that the machine can be run backward. At all other times *C* is drawn to the right so that it contacts slightly with the drum, by means of a small coiled spring (not shown). If, under these conditions, the wheel starts to revolve backward, it instantly jams against *C* and is held stationary. The bell crank, *L*, is connected to a suitable lever near the driver's seat, for the purpose of releasing the cam when the machine is reversed. This lever can be made to interlock with the reverse gear-shift lever if desired. The device is extremely positive in action, there are no teeth to break, and the slight rubbing action of the cam against the drum can be depended upon to keep the latter free from mud or grit. Some such device of this kind should be fitted to every high-powered automobile, and even on a light car it will sometimes be found very useful, such as when the machine stops on a hill from the stalling of the engine. In such a case the car will be held until the engine can be started again without the application of the brake.



A FRICTION SAFETY WHEEL-LOCK FOR AUTOMOBILES.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

SELECTIVE CALL FOR TELEPHONES AND TELEGRAPHS.—W. Palmer, Jr., Ricon, New Mex. The object of this invention is to provide a call by which the central office may call any subscriber on the line without ringing the bells of the others and by which the two subscribers when called may be enabled to communicate with each other without permitting the other subscribers on the same line to hear their conversation.

Of Interest to Farmers.

COTTON-CHOPPER.—J. I. Roberts, Sparta, Ga. The invention is an improvement in that class of choppers which are adapted for use in thinning out rows of cotton-plants, thus leaving a series of stands of such plants duly spaced apart. It may be employed for scraping the surface of a cultivated field for removing small weeds and leaving fresh soil exposed, as is sometimes required in cultivating certain crops.

FERTILIZER-DISTRIBUTER.—C. K. Johnson, Florence, S. C. The distributer is intended especially to be used by cotton-planters in fertilizing fields with guano. The machine is adapted to be advanced along the furrows in which the cotton is to be planted. The object of the invention is to provide means for controlling the feeding of the fertilizer from the distributer.

Of General Interest.

SKIRT-SUPPORTER.—H. C. Deane, Salt Lake City, Utah. It is sought by this invention to provide a device for use in securing a skirt to a shirt-waist, and to provide for holding the skirt and shirt-waist with the proper set in the back. Placing of these garments with the holder may be readily and conveniently accomplished. The holder being formed of thin flat plates which lie close to the body will not present an objectionable appearance when the belt is placed over the same.

LOG-HOOK.—J. D. Vaughan, Zwolle, La. Mr. Vaughan's invention relates to a log-hook; and the principal object thereof is the provision of means for securing logs and the like which can be readily disengaged to permit the weight supported to drop, even when a large weight is engaged by the device.

SAFETY-ENVELOP.—J. Pellerin, Catalia, Alaska. In the present patent the object of the invention is the provision of novel details of construction for an envelop which will prevent the opening of the envelop if sealed without tearing the parts of the same, and thus exposing the felonious attempt.

DEVICE FOR BENDING FORE-AND-AFT SAILS.—J. H. Mitchell, Westerly, R. I. It has been the custom to bind the luff of a fore-and-aft sail to the mast-hoop by spun-yarn or marline. This is tedious and insecure. Further, the luff sags away from the mast and interferes with the set of the former. To overcome this objection the mast-hoop is provided with a shackle which is arranged to engage directly in the eyelet-hole of the sail, thus not only securely holding the sail in proper position, but enabling it to be very quickly bent and unbent.

Heating and Lighting.

OPEN FIREPLACE.—H. C. Cleaver, 3 Eden street, London, N. W., England. The fireplace consists, essentially, of a forwardly-inclined open grate or apertured screen over which the burning fuel descends by gravity, a combined hopper and chute for continuously and automatically supplying the fuel to upper portion of grate by gravity, a fence or kerb situated at the lower margin of grate for limiting descending movement of fuel over the same, and flue (or flues) controlled by damper (or dampers) or other means leading from space beneath the grate to the chimney.

LIFT-PLATE.—E. C. Cole, Chicago, Ill. The invention is an improvement in ranges, and has for its object to provide a novel construction whereby the lift-plate may be tilted to hold it any desired position whenever required. In combination with the lift-plate and lifter, is an ornamental bracket having a vertically-elongated opening through which the lifter is passed, and a hook or hooks for engagement with the lifter.

Household Utilities.

SCREEN.—J. B. Moseley, Danville, Va. A special object of the inventor is the provision of a screen which is simple in construction and which may be readily attached to or detached from a table and which will at the same time be easily manipulated to enable articles to be removed from or placed under the screen.

Machines and Mechanical Devices.

TURPENTINE-BOX-CUTTING MACHINE.—R. L. Ivey and R. D. McDonald, DeLand, Fla. In this invention the machine is adapted to cut in the side of the sap-bearing tree a pocket forming the so-called "turpentine-box," having inwardly-converging walls and a flaring mouth to facilitate access to the sap accumulated in the box for convenience in removing the same.

PAN-AND-ROLLER MILL FOR CRUSHING AND GRINDING.—J. C. Wegerif, Rawreth Rectory, Battlesbridge, Essex, England. One of the main objects in this case is to enable equality of pressure to be maintained throughout the entire length of line of bite or mutual contact between pan and roll in direction normal to the surfaces of both and to insure as far as possible the maintenance of equal rate of wear of the grinding-surfaces of both pan and roll or rolls throughout their entire width. Another, is to subject particles under treatment not only to usual crushing stress, but also to cross-grinding or tensile stress tending to tear each individual particle asunder.

MEAT-CUTTER.—A. W. Johnson, New Brunswick, New Jersey. The chief objects of the invention are to provide means for guiding a rank cutting-blade in such a manner as to prevent it from coming into contact with the bed and to force it to cut uniformly-thin slices, to provide means for guiding three kinds of sharpening-stones, so as to properly sharpen a blade without mechanical skill, and to provide for firmly holding and regularly feeding the meat.

GRABOT-MACHINE.—J. D. Brazier and D. O. Sullivan, Vicksburg, Miss. The invention has reference to a grabot-machine for separating cotton locks and seeds from the hulls as the material comes from the boll-screen. The objects are to provide for the rapid and effective separation of the materials mentioned and the distribution thereof in separate places.

MOLDING-MACHINE.—H. Besser, Alpena, Mich. The principal objects of this inventor are to provide means for rapidly disassembling the mold parts of a machine so as to free the molded object with little effort and in a very short time, to provide means for molding articles of various sizes and shapes by simple adjustments of the mold parts. It relates to a machine for molding plastic materials to form building-blocks, and other articles capable of being formed of a plastic substance.

Prime Movers and Their Accessories.

CARBURETER.—J. McIntosh, Lansing, Mich. The invention relates to a carbureter or vaporizer designed particularly for use in connection with internal-combustion engines, but useful in other connections. The leading object is to provide devices for automatically regulating action of carbureter upon excessive sucking efforts therein, so that when the engine runs at high speed the ratio of air to fuel will be increased proportionately. A further object is to insure thorough spraying of the liquid fuel, and consequently to attain thorough admixture of air and fuel. Further, to easily adjust the float, so action of oil or spirit supply valve may be readily regulated to suit specific gravity of oil or spirit.

Railways and Their Accessories.

GRAIN-DOOR.—J. E. Drake, Blue Rapids, Kan. Mr. Drake's invention relates to a new grain door for railway cars which is an improvement on his previously patented invention. The door is formed of two sections so arranged that either the upper section or both sections may be conveniently swung up and secured in open position. The car may be filled through the upper section. A panel in the lower door section may be raised to permit the contents of the car to flow out before the door is opened. A special feature is means for locking the door sections in open position.

Pertaining to Recreation.

GAME APPARATUS.—R. D. Martin, Tampa, Fla. In this case the object is to provide a game apparatus which is simple and durable in construction, not liable to get out of order, and arranged to afford amusement to the players and to require considerable skill to successfully propel a disk of hard wood, metal, or other material over the surface of a board, by the use of a finger or a mallet, in the least number of strokes.

GUN-SIGHT.—L. Hillabrandt, Johnstown, N. Y. One purpose of the invention is to provide a rim-sight which is of circular form and to provide therefor a removable fine and auxiliary sight which is preferably in the nature of a ring having a spider inner section including vertical and horizontal bars and a central peep or which may be in the form of a disk provided with a peep-hole or scratch-sight.

Designs.

DESIGN FOR A COVER-DISH.—R. L. Johnson, Stoke-Upon-Trent, England. This designer produces an oblong formed cover-dish whose body tapers with a beautiful curve to the bottom, which is encircled with a waved edge. Handles are on the ends. The cover has an exquisitely twisted handle, and the descent of the former to its bottom edge is in fine proportion to the whole effect. Mr. Johnson has also designed another cover-dish. The form is oblong. Scrolled handles are on the ends of the dish, the body of which symmetrically dips to the scrolled edge at the bottom. The cover is surface puffed and ornamentally fluted at the edge.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 7848.—Wanted, address of a manufacturer of silk-covered head tacks, also glass head tacks.

For logging engines. J. S. Mundy, Newark, N. J.

Inquiry No. 7849.—For manufacturers of a tool or machine that will engrave on celluloid or ivory.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 7850.—For manufacturers of air compressors and granite-cutting machinery.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 7851.—For manufacturers of machinery for making buttons from shells; also for decalcomanie or transfer illustrations.

WANTED.—Purchaser for Monazite, Molybdenite and Wolfram. Apply Monasite, Box 773, New York.

Inquiry No. 7852.—Wanted, information concerning the Braum-Viga calculating machine.

I sell patents. To buy, or having one to sell, write Chas. A. Scott, 719 Mutual Life Building, Buffalo, N. Y.

Inquiry No. 7853.—Wanted, information on price of aluminum paper, also makers and sellers of same.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Machine Company Foot of East 138th Street, New York.

Inquiry No. 7854.—For manufacturers of moulds and machinery for making cement shingles and roof tiling, also the address of manufacturers making power and hand power concrete mixers of different designs.

Manufacturers of patent articles. Dies, metal stamping, screw machine work, hardware specialties, machinery tools, and wood fiber products. Quadriga Manufacturing Company, 18 South Canal St., Chicago.

Inquiry No. 7855.—For manufacturers of papier maché.

WANTED.—To secure a party to manufacture a patent Ratchet Drill. Address Drill, Box 773, New York.

Inquiry No. 7856.—For manufacturers of hand power spoon-making machine (from a sheet of brass).

Bates & Peard furnace for bright annealing all non-ferrous metals. Without oxidation. No pickling or cleaning required. C. M. Dally, Agent, 29 Broadway, New York.

Inquiry No. 7857.—For manufacturers of a machine converting peat into fuel.

I have for sale the U. S. and all foreign rights of new patent Improvements in Water Tube Types of Boilers. Great economizer. J. M. Colman, Everett, Wash.

Inquiry No. 7858.—Wanted, information on ship-plumbing, also manufacturers.

Well gotten up typewritten letters will increase your business. $2 per 1.000.
Typewritten Letter Co., St. Louis.

Inquiry No. 7859.—For manufacturers of small cast gears, also of moving picture slot machines.

Inquiry No. 7860.—For manufacturers of Lane's slow-speed rotary quartz crusher.

Inquiry No. 7861.—For manufacturers of nib-making machines, also machine for making the pin.

Inquiry No. 7862.—For manufacturers of a machine for making bricks out of sand and lime.

Inquiry No. 7863.—For manufacturers of wire.

Inquiry No. 7864.—For manufacturers of Buckey tile ditchers.

Inquiry No. 7865.—For manufacturers of machines for renovating butter.

Inquiry No. 7866.—For manufacturers of machinery for making and nailing wooden boxes.

Inquiry No. 7867.—For manufacturers of veneering machinery.

Inquiry No. 7868.—For manufacturers of light metal wheels, such as are used in the construction of corn cultivators.

Inquiry No. 7869.—For parties making mounted springs that would be able to coil up 50 feet of No. 14 insulated wire.

Inquiry No. 7870.—For manufacturers of a three horse evener without a whiffletree; also manufacturers of pen holders with spring inside where pen is inserted.

Inquiry No. 7871.—For manufacturers of razor-grinding machines.

Inquiry No. 7872.—Wanted, address of Zuchanas Mower Grinder Co.

Inquiry No. 7873.—Wanted, brass or copper tack ¾ inch long, with long, oval head, narrow or one with head flat, round, ½ inch diameter, 1-16 inch thick on ⅛ inch wire or cut.

Inquiry No. 7874.—For manufacturers of the Tornado stalk cutter.

Inquiry No. 7875.—For manufacturers of lathes or machines which will turn out any shape of briar tobacco pipes.

Inquiry No. 7876.—Wanted, the name and address of the manufacturers of the Babcock milk tester.

Inquiry No. 7877.—For makers of cheap electric pocket lamps, and small electric novelties.

Inquiry No. 7878.—Wanted, a machine, patented by Mr. Christian Rotts, for cracking off lamp chimneys and tubular glassware.

Inquiry No. 7879.—Wanted, a water still, of capacity of 100 gallons daily.

Inquiry No. 7880.—For manufacturers of blowers.

Inquiry No. 7881.—For makers of vulcanizers, rubber stamps, and supplies for same.

Inquiry No. 7882.—Wanted, Bowe's quick-opening hose couplings.

Inquiry No. 7883.—For makers of bottling machines; also for information regarding the manufacture and bottling of carbonated drinks.

Inquiry No. 7884.—For makers of saw machines, or saw mills for squaring small timbers, from 1 inch up to 8 inches.

Inquiry No. 7885.—For makers of luminous paint.

Inquiry No. 7886.—For makers of small castings cast in metal moulds, to exact size.

Inquiry No. 7887.—For makers of sewing machine needle-threaders, having a flange on both sides.

Inquiry No. 7888.—For manufacturers of gas-making machinery, for illuminating purposes.

Inquiry No. 7889.—Wanted, addresses and catalogues of companies manufacturing small dynamos.

Inquiry No. 7890.—For manufacturers (in Canada) to undertake the manufacture of a candy holder.

Inquiry No. 7891.—For makers of brass trimmings for gosoline launches, etc.

Inquiry No. 7892.—Wanted, makers of leaded glass windows and doors.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9888) R. E. A. says: In reading descriptions of steamers, warships, etc., I am always confused as to the exact meaning of the terms "displacement," "gross tonnage," "net tonnage," "register," and "tonnage." A. The term "displacement" refers to the weight of the ship with everything it contains. A floating body displaces an amount of water whose weight is exactly equal to the weight of that body. If we could weigh the water that would fill the hole which a floating vessel makes in the ocean, we would find that it weighed exactly as much as the vessel itself. "Tonnage" refers to the carrying capacity of a vessel, and this is determined by measuring the internal capacity of the ship; that is to say, the whole space within the hull and deck houses. This amount in cubic feet divided by 40 gives the gross tonnage. If we subtract from that the space which is given up to engines, cabins, etc., we have the net tonnage, or the tonnage that can be given over to a cargo. The registered tonnage is the official tonnage as registered at the Custom House.

(9889) F. O. asks: 1. I am desirous of obtaining a formula for making a cement that will make wood firmly adhere to glass. A. Take 2 ounces of a thick solution of glue, and mix with 1 ounce of linseed oil varnish, or ¾ ounce of Venice turpentine. Boil together, agitating until the mixture becomes as intimate as possible. The pieces cemented should be clamped together for a space of forty-eight to sixty hours. 2. Please give a simple rule, if there be one, that I can tell what day of the week a date is on prior to our present year. A. To find the day of the week any event in the recent past occurred, we must consider that each common year begins and ends on the same day. 1905 began and ended on Sunday, 1906 begins and ends on Monday. A leap year ends one day later in the week than it begins. The days of the week therefore fall backward as we go back in the years one for all years and one more for every leap year. Find the number of years elapsed since the date we wish to find. Find also the number of leap years, by dividing the number of years by four, and reducing this number by one if the date is in the last century, since 1900 was not a leap year, and by two if the date is in the eighteenth century, since 1800 was not a leap year. The sum of the leap and common years will be the number of days of the week by which the day of the week has been moved backward. Divide this by 7 to find how many whole weeks this gives and what remainder there is. Now count the days of the week backward as many as the remainder after dividing by 7, and you will have the day of the week required. Thus, on what day was the Declaration of Independence made July 4, 1776? July 4, 1906, is Wednesday. Since 1776, 130 years have passed; 32 of these would have been leap years; but we subtract 2, for 1800 and 1900, which leaves 30 leap years. The day of the week has moved back one day for each of the 130 years and another day for each of the 30 leap years, or 160 days in all. This equals 22 weeks and 6 days, and 6 days back from Wednesday is Thursday, which was July 4, 1776. New Style was introduced in England in 1752; the 3d of September was called the 14th. This is the first day of New Style, and the day before was September 2, 1752, the last day of Old Style. The rule given above applies to all dates later than September 14, 1752, which day was Thursday. For dates in the future the same rule may be followed, excepting that we must count forward in the week instead of backward. Thus, on what day does January 1, 1920, fall? January 1, 1906, occurs on Monday. Fourteen years intervene, three of which are leap years. This sets the day of the week forward 17 days, or 2 weeks and 3 days, and 3 days from Monday is Thursday. January 1, 1920, will be Thursday. In a similar manner the day for any date may be found. This method is not new, but has been published before, perhaps many times. It appeared in Popular Astronomy, December, 1905, and was derived by the author of that paper from Newcomb and Holden's "Popular Astronomy." Such processes are of considerable interest and value, but unless one preserves them they are soon lost. One's memory cannot be relied upon to retain them.

NEW BOOKS, ETC.

Radium, Radioactive Substances, and Aluminium. With Experimental Research of the Same. By Myron Metzenbaum, B.S., M.D. Cleveland: The Babbitt & Crummell Company, 1905.

The results of the investigations described in this monograph constituted an exhibit at the Building of Mines and Metallurgy of the St. Louis Exposition, and received the bronze medal for Original Research into the Chemistry, Physics, and Medical Value of Radium. The monograph consists of a paper on Induced Radioactivity and Aluminium, which appeared in the Scientific American in 1904; of a short abstract from a chapter on Radium, Its Value in Medicine, contributed to the International Clinics; and of material collected from an article on Radium published in the Cleveland Medical Journal. Upon application to Dr. Myron Metzenbaum, Cleveland, Ohio, a copy of the monograph will be sent free of charge.

The American Annual of Photography for 1906. Edited by Spencer B. Hord and W. I. Lincoln Adams. New York: G. Gennert, 1905. 8vo.; pp. 354. Price 75 cents in paper; $1.25 in cloth.

The American Annual comes to us this year a splendidly-illustrated publication containing an unusual number of interesting special articles besides the customary technical formulæ. Among the special articles referred to may be mentioned as particularly noteworthy the Value of Snapshots, by W. I. Lincoln Adams; How to Make Ovals, by H. M. Gassman; A Summer Outing, by E. S. Kibbe; Immersion Photography, by Dr. Miller. On such subjects as "What is Art?" and "The Broad Movement in Pictorial Photography," the discussions are too indefinite to be of much value to anyone. Still, they have their place in an annual of this kind.

Electroplating. By Paul N. Hasluck. Philadelphia: David McKay, 1905. 18mo.; pp. 160. Price, 50 cents.

This is one of a series of handbooks edited by the Editor of Work, and contains a digest of the matter on electroplating published in this journal, to which have been added several articles by Mr. G. E. Bonney. Complete information is given concerning the tanks, vats, and other apparatus, the batteries, dynamos, and electrical accessories, and the appliances for preparing the work. Silver, copper, gold, and nickel plating are treated, as well as electroplating with various alloys.

Machine Design. By Albert W. Smith and Guido H. Marx. New York: John Wiley & Sons, 1905. 8vo.; pp. 369. Price, $3.

Machine design nowadays is a subject which is considered of paramount importance by the mechanical engineer, and there can hardly be too much good literature relating to this subject. The design of many machines is a result of what may be called machine evolution. The first machine was built according to the best judgment of its designer; but that judgment was sometimes wrong, and some part yielded under the stresses sustained; it was replaced by a new part made stronger; it yielded again, and again was enlarged, or, perhaps, made of some more suitable material; it then sustained the stresses satisfactorily. Some other part yielded too much under stress, although it was entirely free from actual rupture; this part was then stiffened, and the process continued until the whole machine became properly proportioned for the resisting of stresses, and it is one of the objects of this book to deal with "machine evolution." The attainment of economy is an important factor in machine design, and is also dwelt upon. Four considerations of prime importance which are treated are adaptations, strength and stiffness, economy, and appearance. The book is a most excellent one.

Physics. By Charles R. Mann and George R. Twiss. Chicago: Scott, Foresman & Co., 1905. 12mo.; pp. 453. Price, $1.25.

A great deal of time is now devoted to the subject of physics in our high-school and college classes, but the interest of students in the subject does not seem to be as great as it should be. This is largely due to the methods of teaching, because the young mind is naturally very much interested in the phenomena of nature. In the present work the subject is taken up from a new standpoint, avoiding such features of the study as have heretofore tended to befog and confuse the young student. Mathematics is used only where absolutely necessary, and, on such occasions, the equations are made so simple that the student is able to follow the logic they symbolize. Definitions are withheld until the concept is implanted in the mind, whereupon the necessity for the definition is made apparent, and is thus more firmly implanted in the memory. Throughout the entire book a questioning attitude is maintained, so that the teacher instead of maintaining a didactic attitude rather enters into the study with the student. This tends to arouse the interest of the student, and teaches him to observe the phenomena about him, and trains him to draw his conclusions and verify them by experiment. The book follows a continuity of treatment which is pursued to the final chapter. The illustrations are taken from actual photographs of the various things, so that the student is given an idea of the practical application of the subject.

Constructional Steel Work: Being Notes on the Practical Aspect and the Principles of Design. By A. W. Farnsworth. London: Charles Griffin & Co., Ltd., 1905. 8vo.; pp. 248. Price, $3.50.

The employment of mild steel work is rather an innovation in Great Britain, but its use is increasing to such an extent that we are not at all surprised to see English works on the subject. The present volume also deals with an account of the methods and tools of manufacture.

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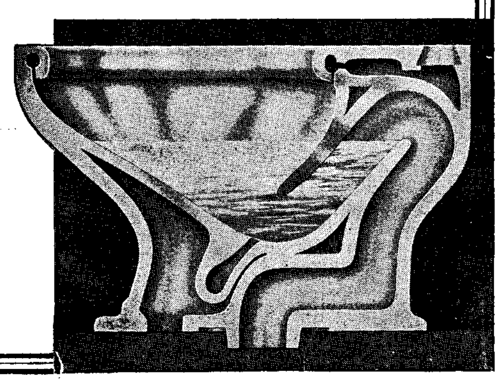

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Packing, steam and water, American Steam Packing Co. 49,459
Packings, Keasbey & Mattison Co. 49,526
Paper, toilet, Stone & Forsyth 49,493
Pens, fountain, L. E. Waterman Co. 49,478
Periodicals and magazines, news, Municipal News Association 49,533
Phosphate, bone, Baugh & Sons Co. 49,371
Pills and tablets, E. Brunor 49,464
Pins, Plume & Atwood Mfg. Co. 49,458
Pistols, Colt's Patent Fire Arms Manufacturing Co. 49,430
Plasters, Johnson & Johnson 49,380
Preparation for certain named diseases, Van Vleet-Mansfield Drug Co. 49,506
Publications treating of electrotechnics, Electrical Review Pub. Co. 49,470
Remedy for certain named diseases, Van Vleet-Mansfield Drug Co. 49,504, 49,507
Remedy for certain named diseases, Wells & Richardson Co. 49,509, 49,538
Remedy for headache, neuralgia, and nervousness, J. G. Munson 49,534
Remedy for the nerves, B. H. Bacon Co. 49,462
Remedy, pile, L. B. Transue 49,554
Rings, gold plated, F. H. Sadler Co. 49,496
Rubber, restored or devulcanized, Philadelphia Rubber Works 49,481
Salt, Francis H. Leggett & Co. 49,519
Saws, Henry Disston & Sons 49,399 to 49,403
Saws of all kinds, E. C. Atkins & Co. 49,469
Seeds, grass and field, W. G. Scarlett, 49,489 to 49,492
Shirt waists and suits, ladies' and misses', Rosenthal Bros. Co. 49,442
Shoulder braces, chest expanders, and suspenders, Knickerbocker Brace Co. 49,383
Silks, dress, Liberty Silk Co. 49,438
Silver flat ware, hollow ware, and tableware, sterling, Hamilton and Hamilton, Jr. 49,473
Soap, Hoffheimer Soap Co. 49,376
Soap, Johnson & Johnson 49,381
Soap and soap powder, laundry and toilet, Beach Soap Company 49,372
Soap, laundry, Magic Soap Co. 49,387
Soap, laundry and toilet, Magic Soap Co. 49,388
Soap, tar, E. A. Olds 49,389
Solder, National Lead Co. 49,409
Tea, Ceylon, Jaburg Bros. 49,523
Teeth and parts connected therewith, artificial, Johnson & Lund 49,524
Tobacco and tobacco products, G. W. Chase & Son Mercantile Co. 49,374
Tobacco, smoking and chewing, Hoffman and Co. 49,377
Toilet water, R. Hudnut's Pharmacy 49,485
Tonic and sedative, uterine, Eli Lilly & Co. 49,545
Tonic beverage, stimulating and non-intoxicating, I needa-Cofpho Co. 49,379
Tonics, Katharmon Chemical Co. 49,525
Trunks, valises, and satchels, Abraham & Straus 49,428
Tubing, flexible, Chicago Tubing & Braiding Co. 49,516
Valves, hydrants, and valve indicators, Ludlow Valve Manufacturing Co. 49,457
Vehicles, certain named, Deere & Webber Co. 49,398
Velveteens, Cocheco Mfg. Co. 49,429
Vermifuge, Van Vleet-Mansfield Drug Co. 49,505
Washboards, American Washboard Co. 49,393
Watch movements, Hampden Watch Co. 49,497
Watches, watchcases, and watch movements, Philadelphia Watch Case Co., 49,482, 49,483, 49,538
Whiskey, Carstairs, McCall & Co. 49,465
Whisky, Jacobs & Garrett 49,475
Whisky, M. Lange 49,477
Whisky, To-Kalon Vineyard Co. 49,502
Whisky, B. S. Flersheim Mercantile Co. 49,511
Whisky, Carstairs, McCall & Co. 49,515
Whisky, E. E. Downham Co. 49,518
Whisky, Geo. H. Goodman Co. 49,521
Whisky, Glasner & Barzen Distilling & Importing Co. 49,522
Whisky, Laventhal Bros. 49,527
Whisky, F. P. Morway & Son 49,532
Whisky, A. Myers 49,535
Whisky, Rosenfield Bros. & Co. 49,542
Whisky, H. Sander 49,544
Whisky, To-Kalon Vineyard Co., 49,551, 49,552, 49,553
Yarn, thread, Elizabeth Mill Co. 49,471

LABELS.

"Dr. M. F. Roberts' Malariacide," for medicine, Malariacide Manufacturing Co. 12,652
"Jersey Cheese," for cheese, L. Jolissaint 12,655
"King Bee—Honey and Rock," for a tonic for coughs and colds, N. Benjamin Son. 12,653
"Pride of Georgia," for syrup, Georgia Syrup Co. 12,656
"Wedgwood," for salmon, Stewart Brothers Co. 12,654

PRINTS.

"Borden's Columbian Brand Evaporated Cream," for evaporated cream, Borden's Condensed Milk Co. 1,571
"Designs for Playing Card Spots or Pips," for playing cards, Willis W. Russell Card Co. 1,572

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

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